APPENDIX A

ACCIDENT PREVENTION PLAN

ACCIDENT PREVENTION PLAN

Remedial Design/Remedial Action Work Plan
Installation Restoration Site 14
Alameda Point, Alameda, California

Prepared for:

Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108

Prepared Under:

Naval Facilities Engineering Command Southwest
Contract Number N68711-01-D-6009
Task Order 0020
DCN: BATL-6009-0020-0005

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November 2008

CONTENTS

ATTACHMENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSIR	Contractor Significant Incident Report
CTO	Contract Task Order
EM	Engineering Manual
EMR	Experience Modification Rate
EMT	Emergency Medical Technician
EZ	Exclusion Zone
DOT	Department of Transportation
IR	Installation Restoration
ISCO	In-Situ Chemical Oxidation
ITSI	Innovative Technical Solutions, Inc.
LWD	Lost Work Day
MSDS	Material Safety Data Sheet
NAVFAC	Naval Facilities Engineering Command
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
RAC	Remedial Action Contract
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROICC	Resident Officer in Charge of Construction
SHER	Safety, Health and Emergency Response
SHSP	Site Health and Safety Plan
SHSO	Site Health and Safety Officer
SOW	Scope of Work
USACE	United States Army Corps of Engineers

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Section 1.0: BACKGROUND INFORMATION

This Accident Prevention Plan (APP) was prepared for the United States Department of the Navy, Naval Facilities Engineering Command (NAVFAC), Southwest Division by Innovative Technical Solutions, Inc. (ITSI), and reviewed and modified by Battelle, for implementation of the Final combined Remedial Design (RD) and Remedial Action Work Plan (RAWP) at Installation Restoration (IR) Site 14, Alameda Point, Alameda, California (Figure 1). Battelle is performing the work under the Environmental Multiple Award Contract (Contract Number N67811-01-D-6009, Task Order 20) for the Navy, NAVFAC Southwest. The initial phases of this work were implemented by ITSI and conducted under a previous version of this work plan. This work was conducted under Indefinite Delivery/Indefinite Quantity Contract Number N68711-02-D-8213, Contract Task Order (CTO) 0026, and also under 8(a) Remedial Action Contract (RAC) Number N68711-05-D-6403, CTO 0009, for the Navy, NAVFAC Southwest, San Diego, California.

This APP was developed in accordance with the United States Army Corps of Engineers (USACE) Safety Manual Engineering Manual (EM) 385-1-1, Appendix A; Code of Federal Regulations (CFR) Title 29, Part 1926, Safety and Health Regulations for Construction; California Code of Regulations (CCR),Title 8, Sections 1500-1938, Construction Safety Orders; 29 CFR 1910.120/8 CCR 5192, Hazardous Waste Operations; the Navy Environmental Health Center Health & Safety Plan Checklist; other applicable regulations; and good industrial hygiene and safety practice.

The APP will be used in conjunction with the Battelle Corporate Health and Safety Program and the health and safety policies and procedures provided in Attachment 1, the Site Health and Safety Plan (SHSP). The procedures and guidelines are based on the best available information at the time of the preparation of the APP and SHSP. Specific requirements may be revised if new information is received or conditions change, especially based upon information gathered during the pre-construction survey. Written amendments will document any changes made to the SHSP and will be included as an addendum to the SHSP.

1.1 Scope of Work/Work Areas

This APP covers the work areas where project field activities will take place. The project site activities included in this scope of work are expected to include the following:

- Mobilize and demobilize equipment, materials, and personnel for the construction effort.
- Perform utility clearances.
- Install, develop, and sample monitoring wells intended to augment existing wells for treatment effectiveness monitoring prior to and after in situ chemical oxidation (ISCO) oxidant injection.
- Conduct baseline and confirmation groundwater sampling events before and after ISCO treatment.
- Inject ISCO oxidant at multiple locations using direct-push methods.
- Transfer, store and dispose of field-generated wastes pending analysis (soil cuttings, purge water, and decontamination rinsate).

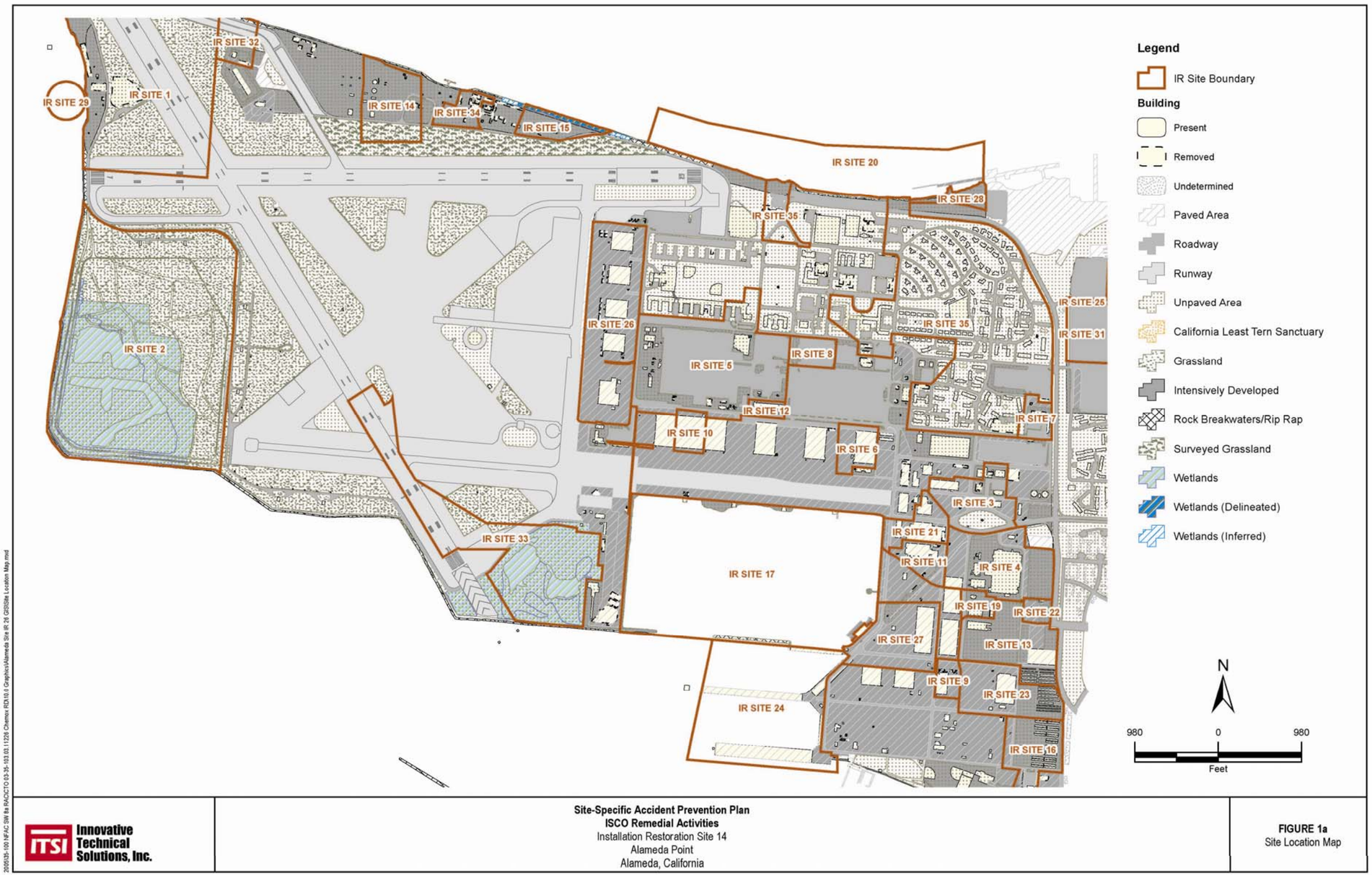

Figure 1. Site Location Map

1.2 Accident Experience

Battelle has performed numerous field investigation projects and has an excellent accident prevention record, as shown in the attached Occupational Safety and Health Administration (OSHA) 300A forms (Attachment 2). Battelle has had an Experience Modification Rate (EMR) factor of 1.04 and 0.74 for 2006 and 2007, respectively. These rates are similar to the national average of 1.0 for all companies performing similar types of work. The Battelle team will work to prevent accidents during this project by following Battelle Policy, this APP, and the USACE Manual EM 385-1-1.

1.3 Phases of Work and Activities Requiring Activity Hazard Analysis

Activity Hazard Analyses (AHAs) have been prepared for the project activities (Attachment 3). The AHAs include:

- General site activities including mobilization/demobilization and utility clearance
- Well installation, development, and sampling
- Chemical oxidation remediation
- Pressure washing/steam cleaning

Section 2.0: STATEMENT OF SAFETY AND HEALTH POLICY

Battelle's Safety, Health and Emergency Response (SHER) Department develops, implements, and manages Battelle industrial hygiene, industrial safety, and emergency management programs that are fully integrated with Battelle operational requirements and provide the services and support necessary to maintain compliance with corporate policies and procedures, as well as applicable regulations and industry standards and policies. The SHER staff members work with researchers to assist them with health and safety compliance. The ultimate responsibility and accountability for compliance and staff safety falls upon Battelle department managers and the staff members themselves.

Battelle is committed to establishing and maintaining an accident-, injury- and occupational illness-free environment. Battelle Corporate Policy 12, Environmental, Safety and Health Program, states "Battelle values human life above all else and strives to provide a workplace free of occupational injuries and illnesses. Battelle values the environment and protects it, the public and future generations from unacceptable risks resulting from its operations." ALL staff must plan and conduct their work in a responsible manner to create and maintain a safe and healthy environment in Battelle facilities and projects. The purpose of this program is to describe the operational framework and guidelines in addressing safety and health issues within Battelle.

Section 3.0: RESPONSIBILITIES AND LINES OF AUTHORITY

Throughout this project, definitive roles and responsibilities will be given to individual staff members. Table 1 provides the name and title of the staff members involved with this project. Mr. Bernard Himmelsbach, the Battelle SHER Representative, has responsibility for Battelle and its subcontractors including authority for final approval of all tasks completed within this project. The Battelle SHER Representative will be consulted as needed during the project and will have final authority in matters relating to health and safety when in question. All site personnel will be briefed and encouraged to report any health and safety violations they observe. Mr. Stephen Rosansky will be the Project Manger. The Site Health and Safety Officer (SHSO), Mr. Derek Payne, has the overall responsibility of health and safety on this project. The SHSO is responsible for day-to-day safety and health, ensuring compliance with this APP, providing daily safety briefings, and performing daily inspections. The SHSO will report all safety violations to the Project Manager. Employees cited for health and safety violations will be counseled or dismissed from the site.

Table 1. Emergency Telephone Numbers

Contact Phone	Number
Emergency (Alameda Police, Fire, Ambulance)	911*
Hospital: Alameda Hospital 2070 Clinton Avenue, Alameda, CA	General: (510) 522-3700 Or (510) 523-4357
Steve Rosansky Battelle Project Manager	(614) 424-7289
Derek Payne Battelle Field Team Leader/Site Health and Safety Officer	Office: (619) 574-4822 Cell: (760) 427-8013
Bernard Himmelsbach Battelle Safety, Health and Emergency Response Representative	(614) 424-4302
Brant Smith XDD Project Manager	Office: (603) 778-1100
Heather Wochnick Navy Remedial Project Manager	Office: (619) 532-0763
Gregory Grace Navy Resident Officer In Charge of Construction, SF Bay	Office: (510) 749-5940
Bob Perricone Navy Alternate Contact	Office: (510) 749-5939
Doug Delong Navy Caretaker Site Office	Office: (415) 743-4713 Cell: (510) 772-8832

*Note: If calling from a cell phone, calls to 911 will reach California Highway Patrol. Caller will need to give location and ask for Alameda emergency response.

Section 4.0: SUBCONTRACTORS AND SUPPLIERS

This section discusses Battelle's coordination with subcontractors and subcontractor responsibilities.

4.1 Subcontractors and Suppliers

Subcontractors and suppliers will include the following:

- Utility locator
- Drilling subcontractor
- Waste Hauler
- Materials suppliers

4.2 Subcontractor/Supplier Coordination and Control

Each subcontractor working onsite will be required to adhere to the APP and SHSP and the requirements presented below. Subcontractors will comply with the specific requirements for site safety as outlined in the SHSP. The Battelle Field Team Leader and SHSO will be responsible for the conduct and control of field related work and subcontractors.

4.3 Subcontractor/Supplier Safety Responsibilities

All subcontractor employees are subject to the same training and medical surveillance requirements as Battelle personnel, as applicable to their job activities, and as outlined in the Site Health and Safety Plan (SHSP; Attachment 1). All subcontractor personnel will be required to sign in daily and attend a daily meeting detailing operations and safety issues. All incidents involving subcontractor employees will be reported to the Battelle Project Manager and SHSO, and a copy of the subcontractor's injury/illness report must be submitted to the Battelle SHSO within 24 hours.

Subcontractors are required to read and sign the SHSP and comply with all requirements of the APP and SHSP. Subcontractors not in compliance will submit a corrective action plan detailing their means to achieve compliance. Subcontractors not correcting deficiencies in an appropriate time frame, based on the deficiency, may be dismissed from the Site.

Suppliers delivering various materials to the Site or providing equipment and/or equipment maintenance will comply with all work rules and regulations. Supplier personnel will not be permitted in restricted work areas without the appropriate training and medical monitoring. Subcontractor personnel will not ride on tractors, forklifts, or similar vehicles unless specific seats with seatbelts are provided. They will be required to follow Battelle hot work rules if hot work is required. Trucks will be loaded and unloaded in a safe and effective manner, and materials will be stored safely only at designated locations. Associated packaging will be properly disposed, and litter will not be scattered or blown from truck beds. Operators of mobile equipment on site must observe all traffic rules, such as speed limits and rights-of-way for pedestrians.

Section 5.0: TRAINING

Training and certification requirements for this project are listed below and discussed in detail in Section 10.0 of the SHSP (Attachment 1).

- The SHSO will conduct site-specific training with all employees to discuss the following: project activities and potential hazards; key personnel and lines of authority; basic work rules and conditions of access to the site; emergency response procedures and route to the hospital; accident and hazard reporting requirements; and Hazard Communication training for handling chemical products.
- Daily tailgate meetings will be conducted.
- All personnel entering Exclusion Zones (EZs) will have completed 40-hour Hazardous Waste Operations training, as well as 8-hour annual refreshers as necessary.
- All employees entering EZs must participate in a medical monitoring program in compliance with the OSHA Hazardous Waste Operations Standard, and have medical clearance, training, and fit testing for respiratory protection.
- The Field Team Leader and SHSO must have completed the 10-hour OSHA Construction Safety training within the past 3 years. The Field Team Leader, SHSO, and the subcontractors' supervisors must have completed an 8-hour training course in Supervision of Hazardous Waste Sites.
- At least two employees on site must be current in First Aid and cardiopulmonary resuscitation (CPR). First aid training is refreshed every 3 years at a minimum, and CPR must be refreshed annually.

Section 6.0: HEALTH AND SAFETY INSPECTIONS

This section discusses health and safety inspections that will be carried out during the project.

6.1 Inspections

Section 9.6 of the SHSP (Attachment 1) outlines the required inspections for the project. The SHSO will conduct daily safety inspections to determine if operations are being performed in accordance with the SHSP and Navy requirements and regulations. Inspection findings will be recorded on a Daily Safety Inspection Form or in a project notebook. Recordkeeping forms can be found in Attachment 4.

The SHSO is responsible for conducting and preparing reports of daily safety inspections of the work processes, site conditions and equipment conditions and submitting them to the Battelle Field Team Leader. The SHSO will discuss any necessary corrective actions with the Battelle SHER Representative and will review new procedures. Copies of these reports will be maintained at the project location. Deficiencies will also be documented on the project health and safety assessment summary/deficiency tracking log. Proof of training and qualifications for the SHSO, Mr. Derek Payne, or his alternate will be available upon request.

The Battelle Project Manager will also conduct site visits and perform site safety audits as necessary. Audit reports will include the number of action items noted during the visit and written confirmation of the corrective actions for each item. Responses will be compiled and provided to program management for review. These reports will be kept in the project file at Battelle's corporate headquarters.

6.2 External Inspections/Certifications

Battelle does not anticipate the use of outside sources to provide safety inspections other than potential audits by Battelle health and safety personnel and/or Project Managers.

As required, safety equipment will comply with appropriate regulations and standards of OSHA; the National Institute for Occupational Safety and Health (NIOSH); the American National Standards Institute; the American Society for Testing and Materials; the United States Coast Guard; or other recognized certification organizations.

Section 7.0: HEALTH AND SAFETY EXPECTATIONS AND COMPLIANCE

This section outlines the goals of Battelle's Safety and Occupational Health Program.

7.1 Safety Program Goals, Objectives, and Accident Experience Goals

Battelle's written safety program goals are to maintain a safe work environment that promotes the following:

- Reducing the risk of injury, illness, and loss of life to employees.
- Maintaining compliance with federal, state and other applicable safety regulations, and minimizing employees' work exposure to potential physical, chemical, biological, and radiological hazards.

The accident experience goal for this project is zero accidents. If accidents do occur, the goal is to mitigate their effects through effective response such that injuries are not fatal or disabling so that there are:

- No lost workday case incident rates
- No OSHA recordable accidents
- No or minor property damage.

7.2 Employee Safety Responsibility Requirements

Battelle is committed to providing a safe workplace for its employees. This Plan and Battelle's Safety and Occupational Health Program have been developed to ensure that its employees' risk of injury is minimized and to ensure their quality of life. Battelle expects all employees to fully comply with all established health and safety policies and to immediately notify their supervisor if they notice a health or safety hazard or someone not complying with established procedures. Violators of the Safety and Health Policies will be disciplined and may be dismissed. Disciplinary action will follow the policy outline in Battelle's Operating Guide 135-3 Disciplinary Action-General Safety Inspection and Disciplinary Action for Violators.

7.3 Managers' and Supervisors' Safety Accountability

Health and safety is everyone's responsibility. Each Battelle project manager has been entrusted with the responsibility of ensuring that the policies and procedures outlined in Battelle's Health and Safety Program, the SHSP and this APP are followed. The health and safety of all project members is the responsibility of the project manager.

Section 8.0: ACCIDENT REPORTING

This section describes Battelle's methods for tracking work hours, safety incidents, and accident reporting.

8.1 Exposure Data (Hours Worked)

Battelle's SHER Representative tracks and maintains incident records including OSHA 300 logs for federal and state reporting requirements. In addition, Battelle formally submits a report of work hours including lost workdays (LWDs), if any, on a quarterly basis to NAVFAC Southwest.

8.2 Accident Investigations, Reports and Logs

The SHSO and SHER Representative conduct accident/incident investigations. A report completed by the SHSO must be submitted to the Battelle corporate office within 24 hours. For Navy projects, a Contractor Significant Incident Report (CSIR) is required to be prepared and submitted in reporting LWD cases, accidents where three or more persons are admitted to a hospital, a fatality, permanent totally disabling injury, permanent partial disabling injury, or property damage greater than $2,000. The CSIR must be submitted to the Resident Officer in Charge of Construction (ROICC) Representative following the accident within 24 hours of the mishap, in accordance with EM 385-1-1 and the OSHA requirements (29 CFR Part 1904). Battelle will prepare the CSIR with appropriate original signatures, and will forward it to the Navy for appropriate action. A copy of the CSIR form template, with instructions and codes, is provided in Attachment 5.

8.3 Immediate Notification of Major Accidents

Battelle will immediately notify the ROICC Representative of any major accident, including personal injury, fire, equipment or property damage, or environmental incident. A full report will be provided within 24 hours. The procedure described in Section 12.4 of the SHSP (Attachment 1) will be followed in response to any major personal injury.

8.4 Accident Response

Accident response procedures are detailed in Section 12.0 of the SHSP (Attachment 1). The nearest workers will immediately assist a person who shows signs of medical distress or who is involved in an accident, as long as the accident scene is first determined to be safe. The Field Team Leader will be summoned and will immediately alert the SHSO of a medical emergency.

The Battelle Field Team Leader or SHSO or both will assess the following information.

- Location of the victim at the work site
- Nature of the emergency
- Whether the victim is conscious
- Specific conditions contributing to the injury, if known

Section 9.0: MEDICAL SUPPORT

Section 12.0 of the SHSP provides details of the medical support for the project. The SHSO is designated as the first response coordinator for medical emergencies. On-site first response medical support will be provided by First Aid- and CPR-trained personnel. For this remedial action, first response medical support will be provided by Mr. Derek Payne and/or Ms. Angela Paolucci. Off-site medical support will be provided by the local Emergency Medical Technician (EMT)-equipped fire department, and by the medical facility identified in Table 1 of this APP. Figure 2 of this APP presents the route and directions to the hospital.

Directions from Main Gate:

1. From the Main Gate, turn right (south) onto Main Street
2. Continue south, Main Street becomes Central Avenue (SR61) and curves east
3. Follow SR61 as it becomes Encinal Avenue
4. Turn right (south) onto Willow Street
5. Turn right (west) onto Clinton Avenue
6. End at 2070 Clinton Avenue

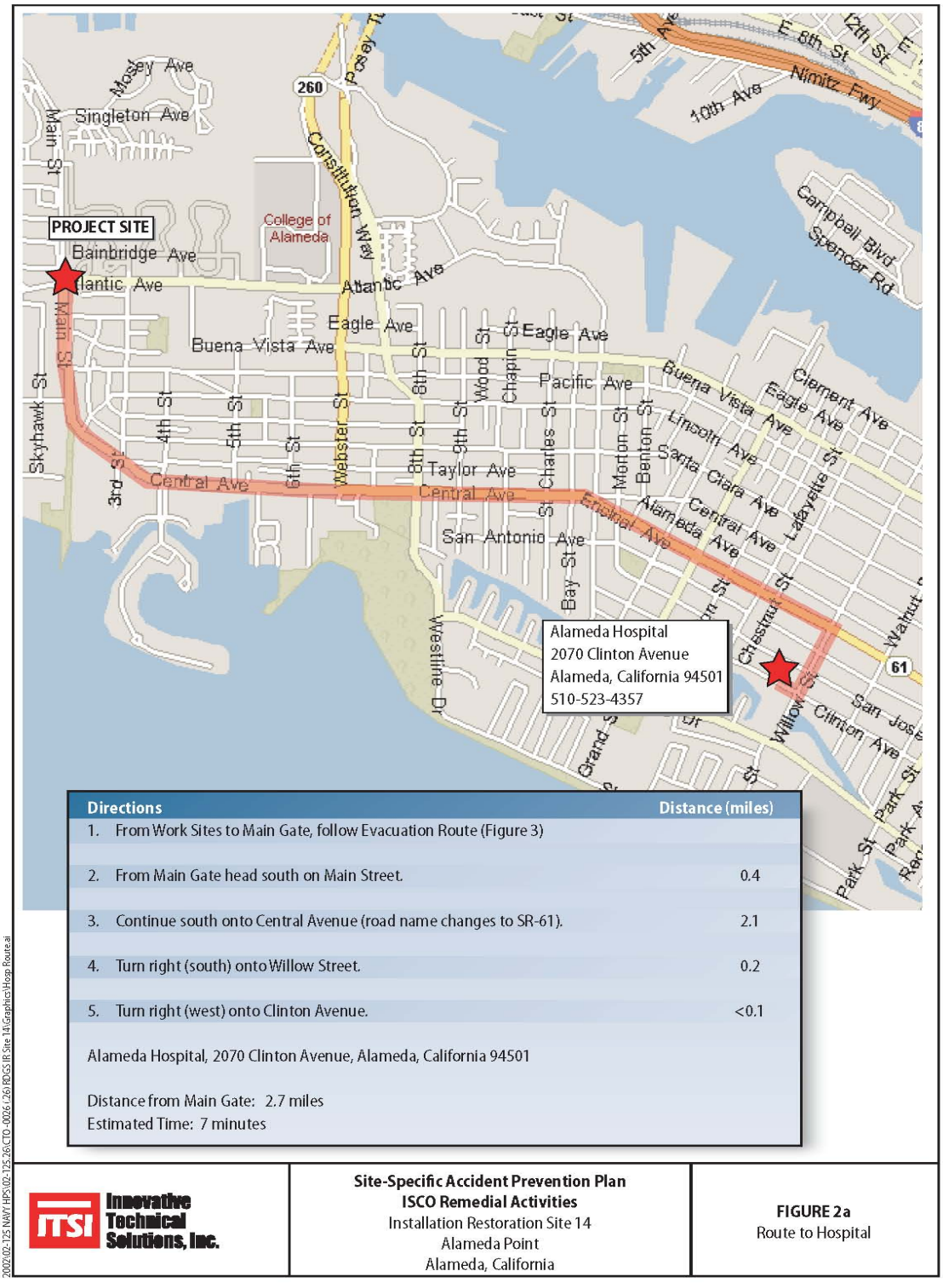

Figure 2. Hospital Route Map

Section 10.0: PERSONAL PROTECTIVE EQUIPMENT

Section 6.0 of the SHSP (Attachment 1) outlines the personal protective equipment (PPE) requirements for the project activities; the SHSP also describes site-specific requirements and conditions; health and safety management experience; training in proper selection, use and maintenance of PPE; potential environmental contaminants; and physical hazards.

Initial PPE levels provided in the SHSP have been established for the site work activities based on the anticipated levels of site contaminants, physical hazards, and the scope of work (SOW). The SHSP, in conjunction with Battelle safety policies and procedures, will serve as the written certification for use of PPE. All selected PPE will be used in accordance with the manufacturer's recommendations and best management practices. Once on site, visual inspection of the work activities by the SHSO may indicate the need for changes in PPE. Any significant changes in the PPE level will be approved by the Battelle SHSO in consultation with the Battelle SHER Representative, Mr. Bernie Himmelsbach, Certified Industrial Hygienist (CIH).

All personnel using respiratory protection will be cleared by a physician for use of a respirator and will be fit-tested to assure they can achieve an acceptable fit. Documentation of physician clearance and results of fit testing will be maintained on site for all employees entering EZs.

Section 11.0: EM-385-1-1 REQUIREMENTS FOR PLANS, PROGRAMS, AND PROCEDURES

This section presents project-specific information related to requirements listed in the USACE safety manual (USACE, 2003).

11.1 Lay-Out Plans

Figure 5 of the RD/RAWP indicates the site lay-out plan. Work zones are identified in Section 7.0 of the SHSP (Attachment 1).

11.2 Em ergency Response Plans

Figure 2 shows the route to the nearest hospital in case of medical emergency. Battelle will verify the route to the facility prior to initiating site work.

In the event of a general site emergency, (e.g., earthquake, fire, etc.), all personnel will observe site conditions and proceed immediately to the designated Gathering Point (Figure 3) by the most direct route that prevents exposure to the emergency condition. Hand-held two-way radios and cell phones will be used as necessary to assist in communication during the emergency.

At the Gathering Point, the Field Team Leader and SHSO will be responsible for evaluating site conditions. If evacuation from the Gathering Point to the Support Area (Figure 3) is warranted, the signal for evacuation will be three long blasts on a vehicle horn repeated at 15-second intervals. In the event that vehicle horns are not working or not readily available, hand-held air horns will be maintained and used as appropriate. The SHSO or his designee will account for all site personnel at the Support Area. The Support Area will provide a location for everyone to receive additional instructions.

The SHSP (Attachment 1) provides additional details regarding emergency procedures, including the following.

- Emergency contacts and communications
- Medical emergencies
- Personal exposure or injury
- Fire prevention and response
- Spills or leaks
- Emergency decontamination
- Emergency equipment
- Adverse weather conditions/natural disasters
- Critique and follow-up of emergency procedures

11.3 Hazard Communication Program

Section 8.8 of the SHSP (Attachment 1) describes the Hazard Communication Program and procedures to be followed on site. This includes on-site maintenance of the updated Material Safety Data Sheet (MSDS) for each chemical product that may be required during site operations; review of the appropriate safety precautions with site employees; labeling of all chemical containers; and proper storage of all chemical products.

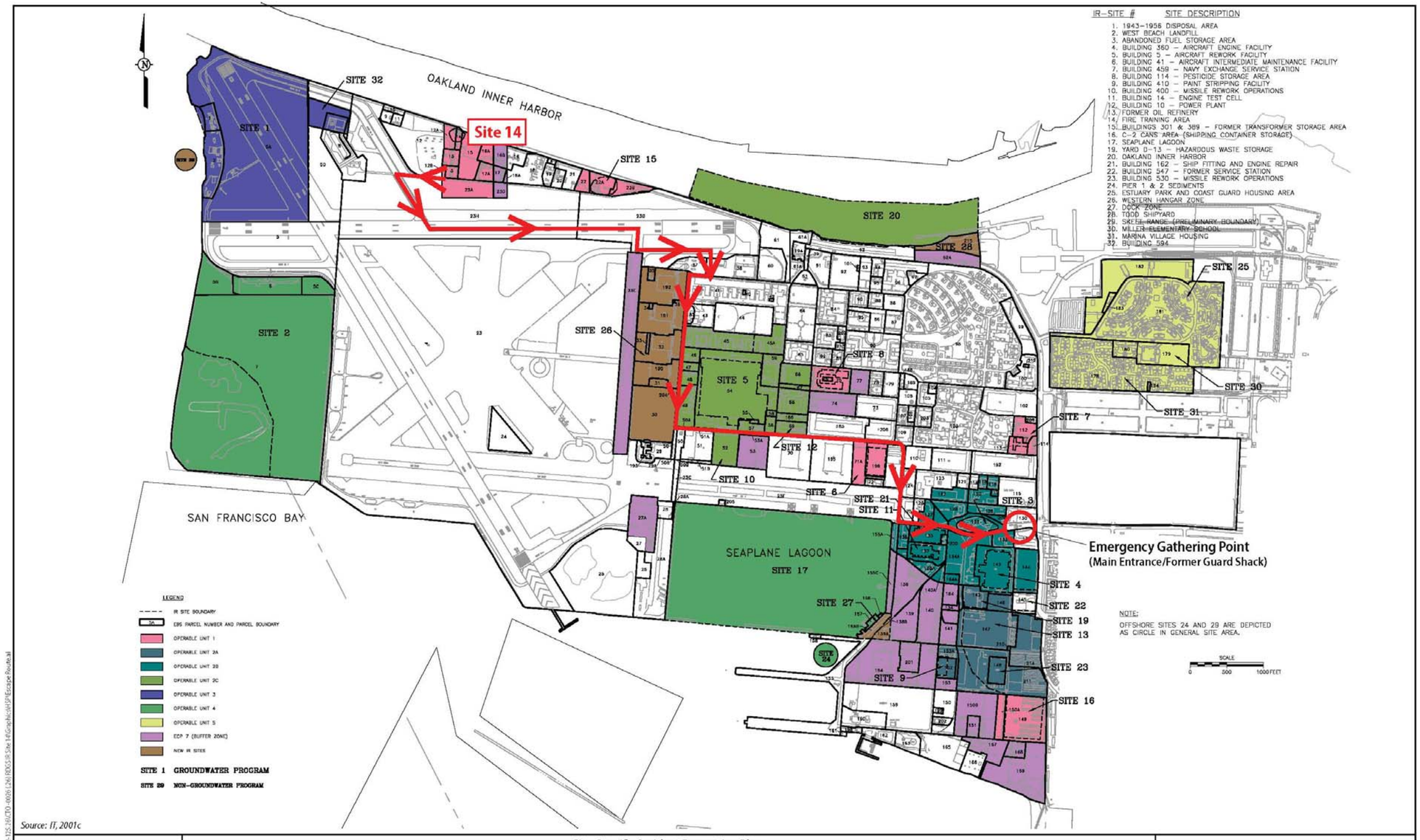

Figure 3. Gathering Point and Support Area

11.4 Respiratory Protection Plan

The SHSP (Attachment 1) details the medical monitoring, training, fit testing, and air monitoring requirements for the project work. The primary objective of respiratory protection is to prevent employee exposure to atmospheric contamination. When engineering measures to control contamination and hazards to the respiratory system, i.e., breathable hazards, are not feasible, or while they are being implemented, personal respiratory protective devices will be used. Air monitoring will be conducted as necessary to confirm that respiratory protection is used as appropriate. All workers assigned to use respirators will have current medical clearance to do so. All respirator users will be trained in proper respirator use and maintenance and will have current respirator fit tests. The SHSO will observe workers during respirator use for signs of stress. The SHSO will periodically evaluate the implementation of the SHSP to determine its continued effectiveness with regard to respiratory protection. All respirators that may be used on site will be NIOSH-approved.

11.5 Health Hazard Control Program

The AHA (Attachment 3) addresses the hazard evaluation for proposed site activities. The AHA will serve as the initial certification of hazard assessment. The AHA is an ongoing process from initiation of the APP to implementation and completion of fieldwork. The second phase consists of further analysis in the field and updating the AHA as necessary. The SHSO, in consultation with the subcontractors and the Battelle SHER Representative, will update the AHA when site conditions or potential hazards change. The updated AHA will be reviewed with all site employees during the daily tailgate safety meeting.

11.6 Lead Abatement Plan

The current SOW does not include lead abatement; a Lead Abatement Plan is therefore not required.

11.7 Asbestos Abatement Plan

The current SOW does not include asbestos abatement; an Asbestos Abatement Plan is therefore not required.

11.8 Abrasive Blasting Plan

An abrasive blasting plan is not required, based on the current SOW.

11.9 Confined Space

A confined space plan is not required, based on the current SOW.

11.10 Hazardous Energy Control Plan

A hazardous energy control plan is not required based on the current SOW.

11.11 Critical Lift Procedures

Critical lift plans are not required, based on the current SOW.

11.12 Contingency Plan for Severe Weather

Contingency plans for severe weather are included in Section 4.1.6 of the SHSP.

11.13 Access and Haul Road Plan

Access and haul roads in the vicinity of the project site are shown on Figure 3. Site vehicles will be operated by Battelle, subcontract personnel and vendors using safe driving and parking practices.

11.14 Demolition Plan

A demolition plan is not required, based on the current SOW.

11.15 Eme rgency Rescue (Tunneling)

Tunneling is not anticipated, based on the current SOW.

11.16 Underground Construction Fire Prevention and Protection Plan

An underground construction fire prevention and protection plan is not required, based on the current SOW.

11.17 Compressed Air Plan

A compressed air plan is not required, based on the current SOW.

11.18 Formwork and Shoring Erection and Removal Plans

Formwork and shoring erection and removal plans are not required, based on the current SOW.

11.19 Jacking Plan (Lift) Slab Plan

A jacking plan (lift) slab plan is not required, based on the current SOW.

11.20 Blasting Plan

A blasting plan is not required, based on the current SOW

11.21 Diving Plan

A diving plan is not required, based on the current SOW.

11.22 Alcohol and Drug Abuse Prevention Plan

Battelle is committed to a drug- and alcohol-free workplace. Pre-employment, reasonable cause, and client-specific drug and alcohol testing is part of Battelle's overall substance abuse program. Post-accident drug and alcohol testing may be a requirement where not prohibited by state or local laws. All truck drivers must meet Department of Transportation (DOT) testing requirements.

11.23 Fall Protection Plan

Personnel who may be exposed to a fall of 6 feet or greater will be protected by fall protection consisting of an approved railing system or personal fall protection system. Personal fall protection will consist of an OSHA-approved harness with a certified lanyard attached from the harness and to a point of attachment rated for such a purpose. All personnel performing work in a lift bucket or on a lift truck will be required to wear personal fall protection. Fall protection is discussed in Sections 4.1.9 of the SHSP (Attachment 1).

11.24 Steel Erection Plan

A steel erection plan is not required, based on the current SOW.

11.25 Night Operations Lighting Plan

Construction will not be performed during hours of low lighting, and as such a night operations lighting plan is thus not required, based on the current SOW.

11.26 Site Sanitation Plan

Battelle will establish and maintain basic sanitation provisions for all employees in all places of employment applicable to the current SOW. For this remedial action, necessary provisions will include potable water and waste disposal receptacles, which will be available to all employees.

11.27 Fire Prevention Plan

Fire prevention procedures are discussed in Section 4.1.5 of the SHSP. Areas adjacent to equipment will be kept free from accumulations of oil, fuel, or other flammable materials, following good housekeeping procedures. Fire extinguishers will be readily available, with a minimum of two on site. The fire extinguishers will be inspected monthly and replaced if not in proper working condition. Fueling of all equipment will be performed in a safe area, away from combustible materials or sources of ignition. Gasoline containers will not be filled in the back of pickup trucks. All hot work will be performed with the appropriate permit, and a fire watch equipped with a working fire extinguisher will be posted in the area.

11.28 Contractor Information to Meet Applicable Requirements of EM 385-1-1

Battelle will provide personnel with the necessary training and experience to execute this project and SOW safely. Employees will be competent in the respective areas of site work for which they will be involved. If it is necessary for site personnel to operate equipment, operators will be qualified for the type of equipment they operate. Chemical, physical, and biological occupational exposure prevention are addressed in the SHSP.

Medical and first aid support will be provided on site by First Aid- and CPR-qualified first responders. The SHSO is designated as the response coordinator for medical emergencies or minor injuries. At least two on-site employees will be First Aid- and CPR-qualified. On-site medical support will be provided by local ambulance/EMT services.

Battelle and its subcontractors will provide suitable PPE as required for the nature of the job being performed, including but not limited to boots, hard hats, safety eyewear, gloves, protective clothing, face shields, and respirators. This PPE is specified in Section 6.0 of the SHSP (Attachment 1).

Employees will use PPE on any task where there is potential exposure to physical hazards such as equipment operation, objects dropping from above, or flying particles, or exposure to toxic or irritating gases, fumes, vapors, liquids, or other materials that may cause respiratory distress or skin irritation. Employees will be trained in the proper use, maintenance, and limitations of PPE.

Fire prevention will be accomplished by the use of inspection and permit systems for all spark- or flame-producing activities. The local fire department will be notified in advance of site operations and informed of the types of work and the locations where fire safety controls are essential. Fire watches will be required, and personnel will understand how to properly operate fire-extinguishing systems and make emergency notifications.

Public safety will be achieved by the means of site control zones and restriction of access to the work areas to authorized personnel only. Site control measures are described in the SHSP. Chemical, physical, and biological occupational exposure prevention requirements are addressed in the SHSP (Attachment 1).

Section 12.0: SITE-SPECIFIC HAZARDS AND CONTROLS

Before initiating a work activity presenting hazards not identified in the initial AHAs (Attachment 3), the SHSO will complete an AHA in consultation with the Field Team Leader, subcontracted personnel, and Battelle SHER Representative. Should the job requirements change; the AHA will be updated promptly to address any new hazard. The AHA will describe ways to safely mitigate classic safety hazards, and chemical, physical, and biological hazards.

Section 13.0: REFERENCES

Battelle. 2007. *Safety and Industrial Hygiene Manual*.

California Code of Regulations (CCR). Title 8 Section 5192. Hazardous Waste Operations and Emergency Response

Code of Federal Regulations (CFR). Title 29 Part 1910.120. Hazardous Waste Operations and Emergency Response.

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ATTACHMENT 1

SITE HEALTH AND SAFETY PLAN

ATTACHMENT 1

SITE HEALTH AND SAFETY PLAN

Remedial Design/Remedial Action Work Plan
Installation Restoration Site 14
Alameda Point, Alameda, California

Prepared for:

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ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
APP	Accident Prevention Plan
AOC	Area of Concern
AST	Aboveground storage tank
bpm	beats per minute
CAA	Corrective Action Area
Cal-OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSIR	Contractor Significant Incident Report
CSO	Caretaker Site Office
CTO	Contract Task Order
dBA	decibel A scale
DCA	dichloroethane
DCE	dichloroethylene
DOT	Department of Transportation
EM	Engineering Manual
EZ	Exclusion Zone
GAP	generator accumulation point
GFCI	ground fault circuit interrupter
IR	Installation Restoration
ISCO	In situ Chemical Oxidation
ITSI	Innovative Technical Solutions, Inc.
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
pH	power of the hydrogen ion (acid to alkali)
PID	Photoionization Detector
ppm	parts per million
PPE	personal protective equipment

ACRONYMS AND ABBREVIATIONS (Continued)

RAC	Remedial Action Contract
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
ROD	Record of Decision
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SHER	Safety, Health, and Emergency Response
SHSO	Site Health and Safety Officer
SHSP	Site Health and Safety Plan
SPF	sun protection factor
SSAPP	Site-Specific Accident Prevention Plan
SWMU	Solid Waste Management Unit
SWP	Safe Work Procedure
TWA	Time Weighted Average
UL	Underwriters Laboratories
USACE	United States Army Corps of Engineers
UST	underground storage tank
UV	ultraviolet
VC	vinyl chloride
VOC	Volatile Organic Chemical
WD	washdown

Section 1.0: INTRODUCTION

This Site Health and Safety Plan (SHSP) was prepared for the United States Department of the Navy, Naval Facilities Engineering Command (NAVFAC), Southwest Division by Innovative Technical Solutions, Inc. (ITSI), and reviewed and modified by Battelle, for implementation of the Final combined Remedial Design (RD) and Remedial Action Work Plan (RAWP) at Installation Restoration (IR) Site 14, Alameda Point, Alameda, California. Battelle is performing the work under the Environmental Multiple Award Contract (Contract Number N67811-01-D-6009, Task Order 20) for the Navy, NAVFAC Southwest. The initial phases of this work were implemented by ITSI and conducted under a previous version of this work plan. This work was conducted under Indefinite Delivery/Indefinite Quantity Contract Number N68711-02-D-8213, Contract Task Order (CTO) 0026, and also under 8(a) Remedial Action Contract (RAC) Number N68711-05-D-6403, CTO 0009, for the Navy, NAVFAC Southwest, San Diego, California. The SHSP is Attachment 1 of the Accident Prevention Plan (APP) and reference for the figures and other attachments provided as part of the APP.

This SHSP and the APP to which it is appended, were developed in accordance with the United States Army Corps of Engineers (USACE) *Safety Manual Engineering Manual* (EM) 385-1-1 (November 2003); Code of Federal Regulations (CFR) Title 29, Part 1926, Safety and Health Regulations for Construction; California Code of Regulations (CCR),Title 8, Sections 1500-1938, Construction Safety Orders; 29 CFR 1910.120/8 CCR 5192, Hazardous Waste Operations; United States Navy Environmental Health Center Health & Safety Plan Checklist; *Department of the Navy Environmental Restoration Program Manual* (August 2006); other applicable regulations; and good industrial hygiene and safety practice.

This SHSP is designed to be part of Battelle's overall Corporate Health & Safety Program. The Corporate Program is incorporated into this SHSP by reference. This SHSP is project-specific and addresses safety and health-related hazards anticipated to be encountered during project activities. This SHSP incorporates Battelle's procedures contained in the *Safety and Industrial Hygiene Manual*.

This SHSP covers all Battelle employees, and serves as the minimum requirement for protective measures for all subcontractors on the site. A copy of this SHSP will be provided to all subcontractors onsite. A copy of this SHSP will be available onsite during all field activities. All subcontractors working on the site are responsible for the health and safety of their own employees, and are responsible for compliance with the provisions of the applicable health and safety regulations. Each subcontractor will provide health and safety equipment for its employees. All onsite personnel, including visitors, are expected to be familiar with, and comply with the provisions of this SHSP.

This SHSP is intended as a practical approach to the activities in light of the potential occupational and public health hazards identified. The procedures and guidelines are based on the best available information at the time of the preparation of this Plan. Specific requirements during the course of the field work may be revised if new information is received or conditions change. Written amendments will document any changes made to this Plan and will be included as an addendum to this Plan.

Section 2.0: SITE DESCRIPTION AND SCOPE OF WORK

2.1 Site Background and Description

IR Site 14 is a part of Alameda Point [formerly the Naval Air Station (NAS) Alameda] that covers a roughly 1,743-acre rectangular area, approximately 2 miles long (east to west) and 1 mile wide (north to south), Alameda, California. NAS Alameda was active from 1940 to 1997 having a variety of Naval operations conducted there. These operations included aircraft, engine, gun, and avionics maintenance; fueling activities; and metal plating, stripping, and painting. The Navy also operated two power plants, a transportation shop, and a pesticide shop. The base had a deepwater port capable of berthing aircraft carriers and a fuel-distribution-pipeline network that transported aviation and diesel fuel to various areas on the base.

IR Site 14 is located in the northwestern section of Alameda Point, north of the former Runway 7/25 and Perimeter Road, and adjacent to the Oakland Inner Harbor. The site is approximately 14.4 acres and was historically used for equipment storage of airfield-related materials, with the northwestern portion of the site used for fire-fighter training activities. The site was originally designated an IR site based on concerns related to the fire training activities; petroleum-related constituents in soil were the primary concern. Subsequent investigations revealed the presence of chlorinated solvents in groundwater, the current focus of the groundwater investigation at the site.

IR Site 14 is primarily open space and is partially paved with a generally flat topography. The site currently includes five buildings (Buildings 26, 120, 121, 122, and 388), two closed aboveground storage tanks (ASTs) (96A and 96B) that contained nonpotable water, petroleum corrective action area (CAA)-2, which is the administrative unit to designate the location of contamination from former underground storage tank (UST) FS-1, and several storm and sanitary sewer lines. In addition, IR Site 14 also contains multiple solid waste management units (SWMU), which include former generator accumulation points (GAPs) 9 and 11, a washdown (WD) area 528, and the following petroleum-related SWMUs: Area of Concern (AOC) 357, AST-179, and AST-528.

Historical activities performed within areas of IR Site 14 considered potential sources of contamination at the site include the following:

- Former Fire Training Area
- Former UST FS-1 (CAA-2)
- Building 528, aboveground storage tank at the northwest corner of Building 528, possible spills along storm drain
- Resource Conservation Recovery Act (RCRA) GAPs 9 and 11
- Ordnance storage at Buildings 120, 121, 122, and 388
- Spills in open areas adjacent to GAP 9

The Fire Training Area was constructed between 1973 and 1979 and included a concrete pad surrounded on three sides by an earthen berm. ANSULITE® fire-fighting foam, carbon dioxide, potassium chloride, and Purple K (a dry chemical extinguishing agent) were used to extinguish training fires. A sump was located in the northeastern corner of the concrete pad within the Fire Training Area. The sump was apparently used for the collection of runoff from fire training activities. The fire department stopped burning in the area circa 1986.

The Final Record of Decision (ROD) prepared for IR Site 14 presents a selected remedy for addressing vinyl chloride groundwater contamination. The selected remedial alternative is full-scale in situ chemical oxidation (ISCO) injection.

2.2 Site Activities

The project site activities included in this scope of work are expected to include the following:

- Mobilize and demobilize equipment, materials, and personnel for the construction effort.
- Perform utility clearances
- Install and sample monitoring wells intended to augment existing wells for treatment effectiveness monitoring prior to and after ISCO oxidant injection.
- Conduct baseline and confirmation groundwater sampling events before and after ISCO treatment.
- Inject ISCO oxidant at multiple locations using direct-push methods.
- Transfer, store and dispose of field-generated wastes pending analysis (soil cuttings, purge water, and decontamination rinsate).

Section 3.0: HEALTH AND SAFETY PERSONNEL AND RESPONSIBILITIES

Onsite personnel will be responsible for continuous adherence to this SHSP during the performance of their assigned work. In no case may work be performed in a manner that conflicts with the requirements or intent of this SHSP. After due warnings personnel violating safety procedures will be dismissed from the site and possibly terminated from this project. All personnel are expected to report unsafe acts or conditions or other safety problems immediately to their Field Team Leader and the Site Health and Safety Officer (SHSO). If there is any dispute with regard to health and safety, assistance should be requested from Battelle's Safety, Health, and Emergency Response (SHER) Representative. The qualifications, responsibilities, and reporting structure for health and safety personnel are described in the following subsections.

3.1 Project Manager

The Project Manager, Mr. Stephen Rosansky, will have overall responsibility for successful and safe completion of the project, and for management of field crews. The Project Manager will be responsible for assuring that project personnel are trained and qualified for their assigned tasks; setting expectations for the safe performance of their work; and assuring that all necessary safety equipment is provided to them. The Project Manager will also be responsible for assuring that all required recordkeeping is completed, including inspections, training documentation, and accident reporting and investigation.

3.2 SHER Representative/Certified Industrial Hygienist (CIH)

The SHER Representative, Mr. Bernard Himmelsbach, CIH, has reviewed and approved this SHSP, will approve all changes to the SHSP during the course of project activities, and will provide support to the SHSO for questions or problems relating to health and safety concerns at the site. His responsibilities also include reviewing and monitoring compliance with this SHSP and other industry standards; implementing corrective measures for health and safety deficiencies; and ensuring required training and medical monitoring of personnel. If, in the course of this project, changing conditions require revisions/additions to this SHSP, the SHER Representative will review the problems and, if necessary, issue new directions/changes to this SHSP. Specific duties of the SHER Representative will include:

- Approving and providing necessary updates to this SHSP
- Providing technical assistance on an as-needed basis
- Arranging for employee exposure air monitoring as required
- Arranging for additional hazard-specific training for employees working on the site, as required.

3.3 Battelle Field Team Leader

The Battelle Field Team Leader, Mr. Derek Payne, will have overall responsibility for implementation of the field activities. He will assure that all activities are conducted in strict accordance with the approved Work Plan and SHSP requirements, while protecting the health and safety of onsite workers. He will oversee the work of Battelle's subcontractors, and will communicate directly with the Project Manager and client representatives.

3.4 Site Health and Safety Officer

The SHSO, Mr. Derek Payne or qualified alternate, will be directly responsible for implementation of, and compliance of site personnel with, this SHSP, and will be onsite or within ready communication at all times. The SHSO will also enforce the minimum requirements of this SHSP for all personnel onsite, including subcontractors. The SHSO will establish contact with all potential emergency response organizations prior to starting work and function as the Response Coordinator in case of an emergency. The SHSO has the responsibility and authority to modify and stop work, and to remove personnel from work areas if conditions warrant. Other SHSO responsibilities will include:

- Reviewing, understanding, and administering this SHSP in the field
- Conducting health and safety oversight of onsite personnel
- Monitoring daily weather and site conditions
- Performing and documenting daily worksite inspections and tracking corrective actions
- Coordinating and conducting daily tailgate health and safety meetings
- Halting project activities, when necessary, for significant noncompliance with this SHSP
- Enforcing the dust control requirements onsite
- Ensuring proper emergency notifications to client personnel
- Investigating exposure incidents and injuries
- Completing incident reports
- Establishing onsite and offsite communications
- Performing the required air monitoring onsite

3.5 Subcontractor Field Team Leaders

All subcontractors will be directly responsible for implementing and complying with this SHSP as the minimum health and safety requirements onsite. Each subcontractor performing onsite activities will designate a responsible person to act as the company's Field Team Leader and competent person for health and safety. Each subcontractor Field Team Leader will act as their employees' response coordinator in case of an emergency and are responsible for oversight of the site activities for their own personnel. They are directly responsible for implementation of, and personnel compliance with, this SHSP. Subcontractor Field Team Leaders will have the following responsibilities with respect to their personnel:

- Preparing an activity hazard analysis for each task subcontracted to perform for review and approval by Battelle's SHSO prior to initiation of on-site work.
- Conducting and documenting daily heath and safety inspections of the subcontractor's work areas
- Ensuring that all site personnel receive the necessary training, medical monitoring, and respirator fit-testing, as required, prior to working onsite
- Perform site-specific training as needed
- Perform personal exposure air monitoring as required.
- Providing regular pre-task health and safety briefings
- Ensuring that employees follow proper hygiene procedures
- Reporting accidents and incidents
- Preparing of safety-related documentation and work logs

3.6 Project Field Staff

All site workers are expected to comply with the requirements of this SHSP, especially requirements for work practice controls and personal protective equipment (PPE). Employees must report all unsafe conditions, accidents, incidents, near misses, and/or injuries that occur at the jobsite to their supervisor immediately.

Section 4.0: JOB HAZARD ANALYSIS

This section summarizes the potential chemical, physical, and biological hazards that may be associated with the project activities. Personnel working most directly with the project activities will have the greatest chance of encountering these hazards; however, all personnel onsite may encounter them at one time or another.

Additional specific precautions are provided in the Activity Hazard Analysis (AHA) for this project (Attachment 3 of the APP). The AHA will be reviewed with the field crew prior to the start of work, each definable feature of work, and as needed during the execution of specific tasks. If additional tasks are identified or added at a later date, or if additional hazards are encountered, the AHA will be revised and the new information will be reviewed with the site personnel.

4.1 Physical Hazards

The primary physical hazards potentially associated with the site are expected to include:

- Drilling equipment hazards
- Equipment and vehicular traffic
- Overhead and underground utilities
- Fire and hot work
- Heat and cold stress/Inclement weather
- Noise
- Head, back, hand and eye injuries
- Slips, trips and falls
- Ladders
- Pressurized lines
- Electrical hazards

4.1.1 Drilling Equipment Hazards. Drilling equipment, including a direct-push rig and a hollow stem auger rig will be used onsite to advance injection point borings and monitoring well borings. All drilling equipment brought onsite will be operated, inspected, and maintained as specified in the manufacturer's operating manual, and according to EM-385-1-1 (USACE, 2003). Prior to bringing earth drilling equipment on the job site, a survey will be conducted to identify overhead electrical hazards and potential ground hazards, such as unexploded ordnance, hazardous agents in the soil, or underground utilities. The location of any overhead or ground hazards will be identified on a site layout plan.

All members of drilling crews will be trained in the operation, inspection, and maintenance of the equipment; the safety features and procedures to be used during operation, inspection, and maintenance of the equipment; and overhead electrical line and underground hazards. Earth drilling equipment will be equipped with two easily-accessible emergency shutdown devices, one for the operator and one for the helper. Drilling equipment will be posted with signs warning the operator of electrical hazards. The equipment operator will ascertain proper clearance before moving equipment. Clearance will be monitored by a spotter or by an electrical proximity-warning device.

Before drilling equipment is moved, the travel route will be surveyed for overhead and terrain hazards, particularly overhead electrical hazards. Drilling equipment will not be transported with the mast up. The exception is movement of the equipment required in drilling a series of closely-spaced holes, ONLY if the following conditions are met: (1) movement is over level, smooth terrain; (2) the path

of travel has been inspected for stability and the absence of holes, other ground hazards, and electrical hazards; and (3) the travel distance is limited to short, safe distances.

Equipment will be set up on stable ground and maintained level. During operation, weather conditions will be monitored: operations will cease during electrical storms or when electrical storms are imminent. Drill crew members will not wear loose clothing, jewelry, or equipment which might become caught in moving machinery. Drill rod tool joints will not be made up, tightened, or loosened while the rod column is supported by a rod slipping device. Augers will be cleaned only when the rotating mechanism is in neutral and the auger stopped; long-handled shovels will be used to move cuttings from the auger.

Site workers will not be allowed on a drill mast while the drill bit is in operation or the drilling equipment is being moved. Auger guides will be used on hard surfaces. The operator will verbally alert site workers and visually ensure all site workers are clear from dangerous parts of equipment before starting or engaging equipment. The discharge of drilling fluids will be channeled away from the work area to prevent the ponding of water.

The use of side-feed swivels collars on drill rods are restricted to those collars which are retained by either a manufacturer-design stabilizer or a stabilizer approved by a professional engineer. Hoists will be used only for their designed intent and will not be loaded beyond their rated capacity. Steps will be taken to prevent two-blocking of hoists. The equipment manufacturer's procedures will be followed and if rope becomes caught in, or objects pulled into, a cathead. Drill rods will be neither run nor be rotated through rod slipping devices: no more than 0.3 meters (1 foot) of drill rod column will be hoisted above the top of the drill mast. Open boreholes will be capped and flagged; open excavations will be barricaded.

4.1.2 Equipment and Vehicular Traffic. Vehicles, trucks and other construction equipment will be used at the site. Only qualified operators and drivers with demonstrated training and experience will be permitted to operate equipment. Operators must ensure that equipment movements are deliberate and predictable. Safe vehicle speeds for each area of the site and each operation will be established, taking into account slope, soil conditions and moisture, types and weights of vehicles, and ground obstructions. All drivers and operators will be required to maintain vehicles speeds which allow them to keep their equipment under control at all times. If operators demonstrate an inability to maintain this control, they will be removed from operation of that equipment or vehicle. Operators of ride-on equipment will wear seat belts at all times of operation. Parking brakes must be set and attachments and buckets lowered to the ground when units are parked. Equipment must be shut off when left unattended. All personnel operating such equipment will be made aware of the presence of other site personnel. Communication between workers on the ground and operators will be by line of sight, utilizing standard construction hand signals. Spotters will be utilized when equipment is backed in areas with limited visibility, or when it is moved in proximity to overhead hazards or utilities.

Surface obstructions, overhead hazards and utilities, road hazards, and vehicle routes will be clearly demarcated using cones, tapes, and/or signs. Heavy equipment will have the right of way onsite. The Field Team Leader will inspect work areas on a daily basis to verify roads and the work area are in acceptable condition.

Onsite personnel will be made aware of the presence of this equipment and the unique hazards of working around each piece of equipment. Ground personnel must stand clear of the swing radius and routes of equipment travel, and must never stand under suspended loads or under blades or buckets. A restricted-access zone will be created under work platform areas. Workers on the ground

must make sure they are visible at all times to operators and drivers, and should maintain line of sight at all times. Ground personnel will be reminded of the need to approach equipment only after acknowledgement from the operator.

All personnel working around heavy equipment must wear high-visibility vests on the outside of all clothing. Hearing protection must be worn by operators and by ground personnel working in proximity to equipment, as needed based on emitted noise levels. Excessive noise can be readily identified by workers onsite by difficulty in hearing verbal communication at approximately arm's length away.

Equipment must be equipped with rollover protection where appropriate, working backup alarms, and must carry at least one ABC-type fire extinguisher. Heavy equipment must be marked with the maximum lifting or load capacity. All equipment must be inspected by a qualified person prior to use onsite. In addition, daily inspections will be performed by operators. Recordkeeping forms for these inspections are included in Attachment 4 of the APP. All heavy equipment repairs will be performed by a qualified person in a protected area.

Fuel storage containers will be protected from damage, marked with NO SMOKING signs, have appropriately-rated fire extinguishers within 25 feet, and have spill control materials and eyewashes readily available.

4.1.3 Overhead and Underground Utilities. All work locations will be evaluated for overhead utilities. Where energized overhead power lines may exist within the work area, warning signs reminding ground crews of the presence of overhead lines will be placed at ground level. A minimum separation distance of 10 ft will be maintained from all high-voltage lines of 50,000 volts or less during all construction activities. Additional separation distance based on voltages will be required for lines with voltages in excess of 50,000 volts.

All drilling and excavation locations will be evaluated for underground utilities. The Regional Utility Notification Center will be notified at least two days prior to the start of excavation, as appropriate. Hand excavation to uncover utilities must precede equipment use within 2 feet of all marked utilities.

4.1.4 Fire and Hot Work. Appropriate measures will be taken to reduce fire risk through proper monitoring of site activities; proper storage, handling, and transfer of flammable liquids; good housekeeping; prohibition of smoking onsite; hot work protection; and the maintenance within ready access onsite of the appropriate fire extinguishers.

Equipment must be shut off during fueling. Equipment and fuel containers must be bonded to the fuel tank at all times during refueling, in order to prevent a fire hazard from static electricity. Refueling shall not occur in areas where combustibles (including tall grass) are present. Each fueling area will have at least one fire extinguisher, with a minimum rating of 20-B:C, located within 25 ft. Generators and gasoline containers SHALL NOT be filled or refueled in the bed of a pickup truck. The generator or gasoline container must be placed on the ground during filling or refueling. A suitable tray or other containment device will be placed beneath the generator or gasoline container to capture any fuel spilled during refueling.

Smoking will not be permitted onsite or near fuel storage or equipment servicing areas. Smoking will be permitted only in the designated location in the Support Area. No smoking or other ignition sources shall be allowed in the area during handling of fuel. Fuel containers must be Department

of Transportation (DOT)-approved. Fuel containers will be completely closed when not in use, and secured to the vehicle if kept in the truck during movement. Fuel storage areas will be protected from vehicular traffic. Gasoline and diesel will not be used as cleaning solvents or for any purpose other than to power vehicles and generators.

Whenever feasible, non-sparking or open flame methods will be utilized. When open-flame or spark-producing hot work is required, including torch cutting, welding, welding slag removal, or grinding, the appropriate hot work precautions will be implemented at all times. Prior to hot work, a Hot Work Permit will be completed. A Fire Watch equipped with a fire extinguisher with a minimum rating of 2-A:10-B:C will be posted prior to commencement of work; the Fire Watch will remain on duty for at least one-half hour after the work has completed. Cutting, welding, and grinding equipment will be inspected immediately prior to the work. If the potential for flammable gases or vapor exists in the area, air monitoring with a calibrated combustible gas indicator will be performed in the area, and hot work will not be permitted if flammable vapors are detected.

The area surrounding the hot work will be evaluated for the presence of combustible materials, including dry brush or grasses. If dry brush or grasses are present, the area will be cleared near the hot work area where feasible. In areas where brush clearing is not feasible, additional measures will be implemented, including:

- The brush and ground in the area of the work will be thoroughly wetted before and after the work.
- Barriers such as plywood or fire blankets will be placed over and/or around the work, so as to positively prevent sparks or slag from reaching any brush or grass.
- The Fire Watch will be provided as required for all hot work, and will be equipped with a rated extinguisher as well as a water hose. The Fire Watch will provide continuous observation of the work, and will immediately thoroughly wet any sparks or slag which may go beyond the barriers. The Fire Watch will remain on duty for at least one-half hour after the hot work has been completed.

Fire extinguishers with a minimum rating of 2-A:10-B:C will be maintained within each active work area, so that the maximum travel distance to an extinguisher does not exceed 75 ft. In addition, Class ABC fire extinguishers will be located in each site work vehicle, and on each piece of heavy equipment. Each service or fueling area will have at least one fire extinguisher, with a minimum rating of 20-B:C, located within 25 ft.

In the event of **ANY** fire or explosion, all activities shall halt, personnel will evacuate the area, and the Fire Department shall be notified immediately. Trained personnel may utilize the appropriate extinguisher to attempt to extinguish an incipient-stage fire only. If a fire requires more than one fire extinguisher, all personnel will evacuate the area and wait for the Fire Department to respond.

4.1.5 Heat and Cold Stress/Inclement Weather. Weather conditions are expected to vary during the fieldwork. Wind and moisture, as well as areas lacking in shade at the site, may combine with low or high temperatures to create unfavorable working conditions. Sudden changes in the weather, extreme weather conditions, and natural disasters can create a number of subsequent hazards such as poor working conditions and slip, trip, and fall hazards. Natural disasters can create many secondary hazards, such as the release of hazardous materials to the environment, structural failures, and fires.

Operations that involve worker exposure to elevated air temperatures, radiant heat sources, high humidity, and direct contact with hot objects or strenuous activities have a high potential for heat stress. With the use of personal protective equipment, the potential for inducing heat stress is exacerbated further. Depending on the planned work activities and the protective clothing anticipated, the heat stress potential must be considered at ambient temperatures at or above 70 degrees Fahrenheit (°F). When impermeable PPE is being worn, physiological monitoring is the preferred and recommended method to track heat stress susceptibility in workers. The SHSO will monitor the site conditions and make periodic ambient temperature measurements, and will implement the appropriate control measures to provide for the comfort and safety of project personnel. Preventive measures such as rest breaks in sheltered areas, availability of appropriate clothing based on weather conditions, and hydration will be implemented for the protection of the workers. At least one quart of potable water per hour per worker will be available onsite at all times when heat stress conditions are present. Workers will be encouraged and be provided the opportunity to drink water at regular intervals outside of the Exclusion Zone (EZ). Workers will have access to a shaded location during hot conditions to take refuge from the heat as necessary to prevent heat stress. Suitable acclimatization periods will be provided for workers to gradually establish their resistance to heat stress, especially during the use of protective clothing.

The SHSO will also monitor workers' conditions for heat stress and implement the appropriate controls, as described below as necessary. If any of the following conditions are present in a worker, they will be removed from heat exposure until their recovery is complete:

- Sustained (several minutes) heart rate in excess of 180 beats per minute (bpm) minus the individual's age in years for individuals with assessed normal cardiac performance
- Recovery heart rate at one minute after a peak work effort greater than 110 bpm
- Elevated body core temperature, indicated by a body core temperature taken under the tongue of 101.3°F for acclimatized workers, and 100.4°F for workers who have not been acclimatized. Body core temperature can be checked with a disposable oral thermometer or intra-aural device before the employee drinks water.
- Symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness

Workers will be trained in the symptoms of heat stress in themselves and their co-workers, the conditions during which it may occur, the precautions to take, and the need to report all observed heat stress symptoms immediately. Heat stress symptoms include:

- Heat Cramps - cramping of muscles usually due to excessive sweating and loss of body salts (most often associated with moderate or strenuous physical activity).
- Heat Rash - a rash produced when working and sweating in hot environments- greatly enhanced by excessive rubbing of clothing or items in direct contact with the skin.
- Heat Exhaustion - excessive sweating, cool clammy skin, fatigue, weakness, headache, un-coordination, nausea, and/or fainting may occur.
- Heat Stroke— the most severe form of heat stress. Heat stroke symptoms include hot, dry skin; no perspiration; nausea; dizziness; confusion; strong, rapid pulse; and coma. The body must be cooled immediately to prevent severe injury or death. Heat Stroke is considered an immediate, life-threatening emergency for which medical care is urgently needed. Emergency medical personnel should be called immediately for assistance.

First aid for heat stress conditions consists of proper evaluation of their condition, removal to a cool area, cooling the victim down, and rehydration. Specific actions which should be taken include:

- First-aid trained persons should be summoned to assist in evaluation of the victim's condition
- If heat stroke is suspected, outside medical responders should be immediately contacted, as this condition should be considered immediately life-threatening.
- Impermeable clothing should be removed as soon as possible following the required decontamination steps, unless the delay could compromise the victim's health
- The victim should be moved to a shaded, cooler location, preferably air-conditioned
- The victim's clothing should be loosened to aid air circulation and removed as decency permits.
- The victim should sit, or lie down with the feet elevated if they are dizzy or at risk of losing consciousness
- The victim should be encouraged to drink cool water if they are not nauseous or losing consciousness
- The victim may be cooled down further by moistening the head, neck and torso and fanning them gently. To minimize the risk of shock, do not drench them with cold water unless advised to do so by medical personnel.
- Persons suffering from possible heat stroke should not be allowed to return to work until after evaluation by a medical professional.

Solar radiation exposures and sunburn will be minimized by wearing long-sleeved shirts, hats, ultraviolet (UV)-rated sunglasses, and gloves to cover exposed skin; using high sun protection factor (SPF) barrier cream for exposed skin areas; and encouraging employees to take cover out of direct sunlight when work activities permit.

Workers will be advised of the appropriate measures to prevent cold stress, including the appropriate layers of insulating and wind and moisture-resistant clothing, and recognition of symptoms of cold stress. If the SHSO observes or suspects conditions of hypothermia, appropriate first aid will be given, including taking them to a warm, dry area to relieve the symptoms.

4.1.6 Noise. Work around heavy equipment always entails the possibility of exposure to excessive noise. In addition, vacuum operations typically produce high levels of noise. Excessive noise can be readily identified by workers onsite by difficulty in hearing verbal communication at approximately an arm's length away. Employees onsite will be briefed on noise hazards and protection as part of the site-specific training, and this information will be included in the regular tailgate sessions and documented. Workers onsite will be offered a choice of hearing protection such as earplugs and earmuffs. Proper use of hearing protection is expected to reduce exposure levels to well below the Permissible Exposure Limit of 90 decibels, A-weighted (dBA). Workers will be trained in the hazards of working in proximity to vehicles and heavy equipment while wearing hearing protection.

4.1.7 Head, Back, Hand and Eye Injuries. Prevention of head, neck, back, hand, and eye injuries is expected to be accomplished through the use of protective equipment and proper work and lifting procedures. Site personnel will be required to wear a hard hat at all times onsite. Hard hats must be worn properly and not altered in any way that would lessen the degree of protection offered. Eye protection,

including safety glasses with side shields, will be required during all work onsite, and especially when airborne objects that may be projected or blown into the eyes are present, or when exposure to hazardous materials may occur.

Wherever possible, material handling will be done mechanically. Where manual handling is absolutely necessary, personnel will be instructed in safe handling techniques, and will be instructed to use the appropriate protective gear to prevent abrasions, cuts, and struck-by accidents. Personnel will also be encouraged to request assistance from other site personnel when lifting large, heavy, or awkward objects (>60 lbs). The following steps describe the proper method for lifting.

- Get a good footing.
- Place feet about shoulder width apart.
- Bend your knees to pick up the load. Never bend from the waist.
- Keep your back straight.
- Get a firm hold. Grasp opposite corners of the load, if possible.
- Keep your back as upright as possible.
- Lift gradually by straightening your legs - don't jerk the load.
- Keep the weight as close to your body as possible.
- When changing directions, turn your entire body, including your feet. Don't twist your body or make awkward moves which force you to be off balance.

4.1.8 Slips, Trips and Falls. Slips and trips on the work site are typically caused by poor housekeeping, lack of awareness of one's surroundings, or the use of unstable equipment (ladders, step-stools, etc.). Proper housekeeping techniques and proper training of workers will minimize this kind of accident. Debris, supplies, and other materials that may present a tripping or slipping hazard will be removed or barricaded to prevent potential injury.

Any personnel who may be exposed to a fall of 6 feet or greater must be protected by fall protection consisting of a rated guardrail system or personal fall protection, consisting of a full-body harness connected via an appropriate certified lanyard to a rated anchor point capable of sustaining a 5,000-pound load per person. The fall protection system must limit a free fall to a maximum distance of 6 ft, with a maximum deceleration distance of 3.5 ft. All fall protection will be inspected by the worker prior to each use. Defective equipment will be replaced immediately. Employees potentially exposed to fall hazards will receive training by a competent person on the required fall protection topics.

4.1.9 Ladders. Ladders will only be used on level, stable surfaces. The choice of ladder type (color code) will depend on the anticipated weight load (i.e., the weight of the person and equipment). All ladders will be maintained in good condition; any ladder with damaged or missing braces or parts will be immediately taken out of service and tagged, and will not be placed back in service until repaired. Each ladder will be inspected by a competent person prior to use. Ladders will be labeled with legible manufacturer’s instructions and warning labels. Ladders will not be painted except for identification marks. Exterior ladders will be secured as necessary to prevent disturbance and falls during use. Tools and materials will not be left on unattended platforms.

4.1.10 Pressurized Lines. Pressurized lines present significant physical risks. High-pressure hoses, such as compressed air lines, may whip around violently if the fittings become disconnected. All hose

ends and connections must be secured to prevent accidental disconnects and to restrict whipping in the case of disconnect. All hoses and related equipment must be inspected on a daily basis for damage. Personnel working with high-pressure lines must take care not to point the stream at any body part, and must wear the appropriate eye, face and skin protection. Prior to disconnection, all pressurized lines must be bled to relieve the pressure, and verified to be depressurized. During ISCO injection, the wellheads and hoses may be pressurized. Prior to opening wellheads or disconnecting injection hoses, pressure should be slowly bled off.

4.1.11 Electrical Hazards. All electrical equipment shall be handled with care by trained personnel. All electrical power tools and extension cords must be protected by ground fault circuit interrupters (GFCIs). Personnel must be insulated or guarded from any energized source or conductive object. Tools should have non-conducting handles and hoses. All electrical equipment must be double insulated or grounded. Power cords must be Underwriters Laboratories (UL) listed. Extension cords must be grounded. Any tools or cords with loose connections, damaged or frayed wiring, or damaged insulation/shielding must be taken out of service immediately and either repaired or discarded. Grounding plugs must not be removed or disabled, and ungrounded extension cords must not be used. Flexible power cords passing through areas that would leave them susceptible to damage shall be covered or elevated.

4.2 Chem ical Hazards

This section outlines the potential chemical hazards associated with the project. During the project activities, employees may be exposed to the site contaminants and chemical products brought onsite for the work.

4.2.1 Site Contaminants. The primary chemicals of potential concern for the present work are vinyl chloride (VC) and other chlorinated volatile organic compounds (VOCs) such as 1,2-dichloroethylene (DCE), and 1,1-dischloroethane (DCA) in soil and groundwater. These VOCs have been detected in groundwater during previous investigations at concentrations ranging from 2.3 to 390 µg/L. Although arsenic and polycyclic aromatic hydrocarbons were also detected at very low concentrations in the soil and groundwater, they are not expected to pose a significant health risk during the project activities, and exposure may easily be controlled through basic hygiene procedures.

The potential routes of exposure for these chemicals are inhalation of vapors and direct contact/absorption with contaminated materials, or through ingestion due to poor work practices and/or poor personal hygiene practices. Symptoms of exposure to high concentrations of these VOCs may include eye and skin irritation, central nervous system depression, headache, vertigo, visual disturbance, fatigue, giddiness, tremors, somnolence, nausea, vomiting, dermatitis, and cardiac arrhythmias. Chronic exposure to the VOCs may also cause liver damage, and VC is listed as a confirmed occupational carcinogen. The California Occupational Safety and Health Administration (Cal-OSHA) Permissible Exposure Limit (PEL) for 1,2-DCE is 200 parts per million (ppm) on an 8-hour Time Weighted Average (TWA) basis; the PEL for 1,1-DCA is 100 ppm. The PEL for VC is 1 ppm.

Personnel exposures during the drilling activities are expected to be minimized by the direct-push method of drilling in the plume area, which minimizes the amount of soil exposed during the work. Exposures to the site contaminants will also be minimized through air monitoring, proper work practices, personal protective equipment, and proper personal hygiene.

Chemicals known or suspected to be present onsite are listed under California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as chemicals known to the State of California

to cause cancer or reproductive harm; these chemicals are VC and 1,1-DCA. The potential for exposure to the public is considered to be minimal, and the control measures taken will serve to further minimize any exposure.

4.2.2 Chemical Products. The chemical products to be used onsite may include sodium persulfate powders and their solutions; fuels and lubricants for equipment; drilling muds and sands; marking paints; laboratory-supplied containers with small quantities of sample preservatives; and calibration gases. Personnel exposure to these materials may occur through inhalation of vapors or airborne particulates, direct contact with materials and subsequent absorption, ingestion due to poor work practices and/or poor personal hygiene practices.

A Material Safety Data Sheet (MSDS) will be obtained for each chemical product brought onsite. Each employer shall assure that all site personnel handling such materials or working close enough to be exposed to the materials are familiar with the contents of the MSDS and any specific precautions needed to work safely with the materials.

Sodium persulfate is an oxidizer and will be used for ISCO on the site. Sodium persulfate will either be supplied as a dry reagent or as a concentrated liquid mixed offsite. If the reagents are supplied dry, they will be delivered to the site in a combination of 55.1-lb bags and 2,200 lb super sacks immediately prior to field injection activities. If the sodium persulfate is supplied as a liquid, it will be premixed offsite and will be supplied in a concentrated form (200 g/L to 400 g/L) in 55 gal drums or in up to 5,000 gal tankers. The sodium persulfate will be stored in a secure location onsite. The oxidant will be diluted to the target concentration prior to injection.

Sodium persulfate is a strong oxidizer and is very corrosive which may cause eye and skin burns or irritation. Sodium persulfate is known for having significant corrosive effect on materials; as such, all materials, lines, and fittings used to mix and inject this chemical will be evaluated for compatibility prior to their use onsite, and will be inspected daily prior to the shift to ensure continued integrity of fittings.

As such, personnel working with these materials will be required to utilize a high level of eye, face, and skin protection, and will stand well away from pressurized lines and equipment whenever possible, especially during the injection process. American National Standards Institute (ANSI)-rated eyewashes will be readily available. An emergency shower will also be available onsite whenever these chemicals are in use. Oxidant dust is an inhalation hazard; employees who may be exposed to this dust, will utilize a tight-fitting respirator with high-efficiency dust cartridges if engineering controls to mitigate and control the dust are deemed insufficient by a qualified person (such as the SHSO).

Fuels handled onsite may consist of diesel and gasoline. In addition, spray paint propellants and mastic removers typically consist of solvents. The fire hazards associated with these materials will be addressed as discussed in the Physical Hazards section. Personnel will utilize the appropriate storage and handling precautions and protective equipment, including handling these materials only in well-ventilated areas, preventing spillage, storing in ventilated areas away from incompatible materials, etc.

Some laboratory analytical methods require preservation of samples with hydrochloric acid and nitric acid at low pH at the time of sample collection. The containers with preservatives are usually pre-prepared and provided by the laboratory. Although the quantities of these acid preservatives are small, dermal or eye contact may occur through breakage or accidental splashing. Employee exposure to these preservatives will be minimized by good housekeeping practices to avoid spilling, breaking, or splashing and by utilizing the Level D safety protection required for this project.

Isobutylene gas is used for calibration of direct-read instruments, and will be brought onsite in extremely small quantities (e.g., a 1-pound compressed air cylinder). Exposure may occur through inhalation; however, exposures are expected to occur only at low concentrations and only during calibration activities. Isobutylene is a simple asphyxiant and is non-toxic; as such, there is no PEL. No specific air monitoring is anticipated for this gas, as the exposure to project staff is expected to be insignificant.

4.3 Biological Hazards

Potential biological hazards associated with project activities may include ticks, biting or stinging insects, spiders, snakes, poison oak, and bloodborne pathogens.

4.3.1 Ticks. Ticks attach to their host's skin and feed on its blood, creating an opportunity for the transmission of disease. The first symptoms of tick-related disease are flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain. If treated promptly by a physician, most individuals recover fully in a short period of time. If not treated, more serious symptoms can occur. Recently, Lyme disease has been the most prevalent type of disease transmitted by ticks in the United States. If an employee believes a tick has bitten him/her, or if any of the signs and symptoms appears, the SHSO or Field Team Leader will direct the employee to visit a physician for examination and possible treatment.

When working in areas that might be infested with ticks, personnel should limit the amount of unprotected skin. Light-colored clothing is preferred for higher visibility of ticks. If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek® coveralls may be used for added protection. Personnel should examine their own and their co-workers' clothing frequently for the presence of ticks and should avoid contact with bushes, tall grass, or brush as much as possible when walking in wooded areas.

If a tick is discovered, it should be detached with a fine-tipped tweezers, not with the fingers. The tick should not be twisted as it is detached, and its bloated body should not be squeezed. All parts of the tick should be removed, and the bite area should be washed thoroughly with soap and water and disinfected with alcohol or a similar antiseptic after the removal. The tick should be saved in a small container labeled with the date, the body location of the bite, and the likely source of the tick.

4.3.2 Stinging Insects. Stinging insects present a serious threat to personnel, and extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects. Nests and hives for bees, wasps, hornets, and yellow jackets often occur in the ground, in trees and brush and under the eaves of buildings. Work areas will be checked for obvious nests and hives before work is started.

Insect stings are responsible for more deaths in the United States than the bites and stings of all venomous creatures. This is due to hypersensitivity and/or sensitization to toxins from repeated stings, which can result in anaphylactic reactions. Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and/or respiratory passages. Individuals who are hypersensitive to such stings and have life-threatening allergies should carry a kit containing antihistamine and epinephrine, and will not work in areas where there is a significant potential for insect stings.

Bites and stings can be painful and may elicit an allergic reaction. To reduce the pain, ice should be placed over the sting and an analgesic corticosteroid lotion applied. If the stinger is embedded

in the skin, it should be removed by teasing or scraping rather than pulling. If simple first-aid measures do not alleviate the symptoms, the victim should be taken to the nearest medical center.

4.3.3 Spiders. The spiders of greatest concern are the black widow and the brown recluse. These spiders are of special concern due to the significant adverse health effects that can be caused by their bites. The black widow is a coal-black, bulbous spider. The female, whose bite is toxic, has a body length of approximately 1/2 inch and an overall length of about 1-1/2 inches, with a bright red hourglass marking on the underside of the abdomen. The black widow is usually found in dark, moist locations, especially under rocks and rotting logs, and may be found in outdoor toilets. The brown recluse is brownish to tan in color, rather flat, 1/2 to 5/8 inches long, with a dark brown "violin" shape on the underside. It is most often found in trees or in dark locations.

There is no effective first aid treatment for either of these bites. Except for very young, very old, or weak victims, these spider bites are not considered to be life-threatening; however, medical treatment must be sought to reduce the extent of tissue damage caused by the injected toxins.

4.3.4 Snakes and Rodents. Snakes may be present in the work area. Workers will be advised to avoid reaching into areas where they cannot see and under items resting on the ground, and to avoid walking through brushy areas. If a poisonous snake is observed, the SHSO should be advised, and a warning given to site personnel to avoid walking in the area. If a person is bitten, an identification of the snake should be made if possible, and the person transported immediately to the medical center.

Workers should also be aware that if there is evidence of the presence of rodents, the hazards associated with exposure to Hantavirus may be present. Site personnel must be warned to avoid direct contact with dead rodents or dried fecal material, and to avoid exposure to airborne dust where dried rodent fecal matter may be present.

4.3.5 Poison Oak or Ivy. Poisonous plants may be present at the sites. The plants contain a resin that causes a delayed allergic hypersensitivity reaction on contact. The resin is active in live, dead, dry, and burned plant parts, and may be carried through the air. Signs and symptoms are usually evident within 24 to 48 hours after exposure. These include burning, stinging, and blisters. Site personnel should notify the SHSO if these plants are observed. If exposure or contact occurs, wash the affected area, but do not spread the resin to unexposed areas.

4.3.6 Bloodborne Pathogens. Bloodborne pathogens are microorganisms present in human blood that can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus and human immunodeficiency virus. All employees will be responsible for identifying potential exposures, and reporting them to their Field Team Leader and/or SHSO. It is anticipated that the only potential exposure to bloodborne pathogens may occur during first aid given to injured persons onsite.

If a potential for exposure to bloodborne pathogens is encountered, first aid responders will don the appropriate PPE from the site first aid kit, which may include latex or nitrile gloves, safety glasses, and cardiopulmonary resuscitation (CPR) shields. Minimum safe work procedures to minimize the risk of employee exposure, including the appropriate hygiene practices, are presented in Battelle's Corporate Health and Safety Program.

Section 5.0: AIR MONITORING

This section describes the air monitoring procedures to be followed during site activities, the Action Levels which will require corrective action or upgrades in personal protection, quality control procedures, and communication of results to the workers. The provisions of this Plan may be modified based on the results obtained and/or on changes in field conditions. Such modifications shall be made in writing as addenda to this SHSP.

The potential airborne hazard onsite consists of VOCs. The purposes of the air monitoring program is to provide timely, relevant, and accurate indications of the levels of airborne hazards, in order to assess appropriate control measures – such as source control; appropriate response measures – such as evacuation from area and work alteration or cessation; and protocols for upgrading respiratory protection.

5.1 Monitoring Methods

During all intrusive activities and handling of materials that may generate VOC vapors, real-time air monitoring will be performed utilizing a calibrated photoionization detector (PID), which measures organic vapors in the ppm-v range. Although the PID provides indications only of total airborne organic vapors, it does provide timely information of airborne organic vapor concentrations, so that immediate response measures may be taken. Monitoring will be conducted throughout the work zone, with special focus on the breathing zone of the workers most involved with the activities. Monitoring will be conducted regularly during all periods of active work with these materials, and continuously during intrusive work in uncharacterized areas. Intermittent air monitoring will be conducted during water level measuring and groundwater sampling. Non-intrusive activities, such as utility clearance and surveying, will not require air monitoring. In addition, site personnel will be advised to be aware of and report any visible or odor indications of the presence of contamination.

Personal exposure air samples will be collected at the discretion of the SHER Representative. If conducted, these samples will be collected utilizing the appropriate National Institute for Occupational Safety and Health (NIOSH) method with subsequent laboratory analysis. Monitoring frequency will be in accordance with any applicable California Occupational Safety and Health Administration (Cal-OSHA) Standards, based upon type of work performed, previous monitoring results, and the judgment of the SHER Representative. Although a time delay exists between collection of the samples and receipt of the analytical results, these samples provide an indication of exposure levels to specific chemicals during the work, so that work practices may be modified for ongoing activities as necessary.

5.2 Action Levels

Once field work has commenced, the breathing zone will be monitored for organic vapor levels. If the PID detects sustained elevated concentrations of organic vapor above background, up to 5 ppmv, in the breathing zone for 5 minutes, air monitoring will be continued in order to identify the source of the vapors and to see if vapor controls can be implemented (i.e., move upwind of the source). If PID levels are sustained between 5 and 10 ppmv in the breathing zone, the work activities will be immediately modified (i.e., respirators will be donned) or suspended. If PID levels are sustained at 10 ppmv or higher in the breathing zone, work will be suspended and personnel removed from the area. In addition, the SHSO or Project Manager will report the occurrence to the Navy Remedial Project Manager (RPM), the Caretaker Site Office (CSO), and/or the Resident Officer in Charge of Construction (ROICC).

These action levels are established conservatively enough to maintain exposures to the site contaminants to well below their respective PELs (including VC) through engineering and administrative

controls. This is necessary as a NIOSH-approved air-purifying respirator cartridge is not available for VC.

5.3 Air Sampling Maintenance and Quality Control

All air monitoring will be conducted by personnel who are qualified to operate and interpret results from the instruments utilized. All direct reading air monitoring equipment will be calibrated before and after each period of use in accordance with manufacturer's recommendations and standard industrial hygiene practice. The PID is calibrated to isobutylene and the records of calibration will be maintained onsite. A copy of the Air Monitoring Log Form is included in Attachment 4 of the APP.

Personal exposure sampling, if conducted, will be performed utilizing NIOSH methods. Air sampling pumps will be calibrated for flow rate prior to, and immediately after sampling. The appropriate number of field blank samples specified in the method will be collected and analyzed. Samples will be submitted to a laboratory that holds accreditation from the American Industrial Hygiene Association (AIHA).

Air monitoring data will be reviewed by the SHER Representative. Reviews will include the sampling procedures followed, recordkeeping, and validity and accuracy of the data, as well as interpretation of the data. The reviews will also include any recommendations for changes in employee work practices or work activities, as appropriate, in light of the results obtained from the monitoring program.

5.4 Communication of Results

Site personnel will be advised of the results of all real-time air monitoring pertaining to their work as the readings are taken. In addition, the air monitoring results will be reviewed during the next day's tailgate safety meeting.

The results of personal exposure air sampling, if conducted, will be communicated to the employees monitored, and to the representative group of employees, as appropriate, verbally at the next site safety meeting after results are received and verified, and in writing within five working days of the monitoring event. Copies will be maintained in the site safety records. Each employer is also required to maintain these records in the employee personnel/medical file, and provide the results to the physicians who carry out the medical monitoring examinations.

Section 6.0: PERSONAL PROTECTIVE EQUIPMENT

Specific designations for PPE are identified in the appropriate AHA for each task. General guidance for PPE is identified below. All PPE must meet ANSI standards, where applicable. The minimum level of protection for personnel working onsite is Level D PPE, which includes:

- Work clothes
- Steel-toed footwear
- Safety glasses
- Hard hat
- High-visibility vest/garment

During activities where skin contact with contaminated soil or groundwater is a potential exposure mechanism, such as handling of potentially-contaminated drilling or sampling equipment or pressure washing, the appropriate protective clothing will be utilized to prevent such exposure. Chemical goggles or safety glasses will be worn during all activities with a splash potential.

During activities with potential contact with liquid oxidants, sodium hydroxide, employees will utilize a high level of eye, face, and skin protection, including chemical goggles and face shield, nitrile or neoprene gloves, and polyethylene-coated Tyvek® apron, sleeved polyethylene-coated Tyvek® apron, or polyethylene-coated Tyvek® coveralls.

Respiratory protection is not anticipated to be used during this project, as noted in Section 5.2, as the action levels were established conservatively enough to maintain exposures to the site contaminants to well below their respective PELs (including VC) through engineering and administrative controls. This is necessary as a NIOSH-approved air-purifying respirator cartridge is not available for vinyl chloride.

All personnel using respiratory protection, including voluntarily, must meet all requirements of the respective employer's Respiratory Protection Program, including medical clearance to wear a respirator, fit testing, and training on the proper selection, use, and limitations of respirators. Voluntary use of respiratory protection is allowed, but may only involve equipment provided by the employer. Voluntary use of filtering face-pieces (dust masks) will also be allowed for nuisance dust only.

Hearing protection, when required, will consist of the worker's choice of earplugs or earmuffs. Workers will be instructed to utilize hearing protection whenever normal conversation at approximately three feet or arm's length becomes difficult due to work area noise levels.

Section 7.0: WORK ZONES AND SITE SECURITY

This section presents work zone designations and site security procedures. The site is located within the boundaries of the Base, and all applicable Base security provisions will be followed by workers. Additional restrictions within the overall site will consist of establishment of EZ at each area where contaminated materials are handled, Decontamination Zones for equipment and personnel cleanup, and Support Zones.

7.1 Exclusion Zones

The active work areas around each area where contaminated materials are encountered or may be exposed will be considered EZs. The EZs will be established to accommodate all equipment, personnel, and vehicular movement where the potential for exposure to hazardous materials exists, such as drill rigs, support truck operations, waste handling, etc.

The EZs will be modified, as necessary, as the work progresses at a specific location. The EZ will be demarcated by barricades, warning tape, temporary construction fence, or other appropriate measures, as well as signs posted in English and, if appropriate, in any other language necessary for all workers and visitors to clearly understand. Access to these areas will be limited to authorized personnel with the appropriate protective equipment, who have met the training and medical requirements, as specified in the appropriate sections of this SHSP, appropriate for their work effort. Personnel working in these areas will check in and out of the area, and utilize the buddy system.

Site activities in the EZ will stop if unauthorized personnel enter the area and work will not resume until those individuals have exited the area. Eating, drinking and smoking will be prohibited in these zones in order to prevent inadvertent ingestion of contaminated materials.

7.2 Decontamination Zones

Decontamination zones will be located immediately adjacent to each EZ. All site personnel working in the EZ must pass through the Decontamination Zone before proceeding to the Support Zone. PPE cleaning and storage areas will be included in the Decontamination Zone. Equipment and vehicle decontamination areas will be located immediately adjacent to the work area, in a manner that prevents tracking of contamination from the source location to other areas. A temporary equipment decontamination wash pad will be constructed as necessary; all wash water will be collected for disposal.

7.3 Support Zone

Support Zones will be established outside the Decontamination Zone. Eyewash, first aid kits, fire extinguishers, potable water, emergency communications and sanitary facilities will be maintained in the support zone.

Section 8.0: EXPOSURE CONTROL METHODS

8.1 General Approach and Schedule of Implementation

Employee exposure to the site contaminants may be minimized through engineering and administrative controls, and through the use of PPE. Engineering and administrative controls will be used wherever possible, even if PPE will also be utilized. Exposure control methods will be implemented before any work with contaminated materials is performed onsite, and protective measures will be utilized at all times during soil disturbance or other activities on the work site with the potential to create exposure. These controls include careful materials handling; establishment of work zones; establishment of appropriate housekeeping and decontamination procedures; assignment of the appropriate PPE; and provision of hygiene facilities for personnel hand and face washing. In addition, all personnel must show proof of the appropriate level of training before working on the site.

8.2 Work Zones

Work zones will be established during all work involving hazardous materials handling, in accordance with the provisions of Section 7.0. Access to the work area will be limited to authorized personnel with the appropriate protective equipment and training. All personnel working in an EZ must perform the required decontamination procedures upon exiting the work zone.

8.3 Engineering and Work Practice Controls

Engineering controls for any contaminated materials handling activities shall consist of those methods that produce the least airborne concentrations of hazardous materials, and covering of all potential sources of contaminated vapors. All work activities will be evaluated prior to implementation for their potential to produce airborne hazards, and the appropriate proactive measures will be implemented. Waste will be handled in such a manner to minimize their spread. Contaminated materials will be stored in approved containers pending disposal.

Dermal exposure will be controlled by limiting contact, the use of protective clothing as appropriate, and personal hygiene. Ingestion hazards will be controlled by strict limitation of eating, drinking, and smoking in the EZs, and by rigorous application of decontamination and personal hygiene protocols.

8.4 Housekeeping

Active work areas and equipment must be cleaned daily to prevent the accumulation of contaminated materials, and waste materials must be contained on an ongoing basis. Dry sweeping and compressed air shall not be used to clean up or remove contaminated debris or dirt. Removal of materials from equipment or protective clothing by blowing, shaking, or any other means which may disperse materials into the air is prohibited. All eating areas shall be kept clean and sanitary.

8.5 Decontam ination

8.5.1 Personal Decontamination. Employees exiting the EZ will carefully remove disposable contaminated PPE and place them in the appropriate container. As needed, wash tubs with soap and water and rinse tubs will be provided for decontamination of footwear and outer gloves that will be re-used.

Respirators, if utilized, will be cleaned with respirator wipes unless gross contamination requires heavier cleaning in separate wash and rinse tubs. Soap and running water will be available for personnel to wash up after work or if any skin contact occurs during the workday.

8.5.2 Equipment Decontamination. Small equipment will be washed in the same manner as contaminated PPE (i.e., with a brush and soapy water and rinse water). The primary method to be used to prevent equipment or truck contamination is to prevent or minimize travel through contaminated materials. Any equipment that comes in contact with contaminated materials will be properly cleaned before being removed from the site. Equipment decontamination will be in proportion to the degree of contamination encountered.

Equipment decontamination is expected to require only gross removal of soils from buckets or wheels. Shoveling, brushing or wiping will be the primary decontamination methods used for equipment. Wastes removed from equipment will be returned to the appropriate waste stockpile or placed with the load of waste for transport. All trucks and equipment exiting the site will be inspected immediately prior to departure to assure cleanliness, and to assure that materials are not tracked onto the road. If necessary, additional cleaning of the tires will be performed before trucks enter roadways.

If necessary, when heavier contamination is present, and for drilling augers/flights, equipment will be washed with a pressure washer. Any pressure washing will be performed over a lined area. Decontamination will proceed until all soil and residues are removed. Waste liquids will be contained of in approved containers and disposed of in accordance with all applicable regulations.

8.5.3 Decontamination Waste Handling. Decontamination wastes are expected to include disposable PPE and wash/rinse fluids. Decontamination wastes will be placed in approved containers to await disposal at the appropriate facility.

Decontamination fluids are expected to be containerized onsite in DOT-approved containers prior to disposal. If approval for discharge to the sanitary sewer is not received due to contaminants exceeding regulatory limits, liquid wastes will be disposed of at a licensed waste disposal facility based upon analytical results from representative samples, under the appropriate documentation, (e.g., bill of lading or manifest).

8.6 Inspections

The SHSO and Field Team Leader will make daily inspections of the work site and employee work practices to ensure compliance with this SHSP, note changed conditions, and identify new hazards. These inspections will be recorded in the daily log, and all necessary corrective actions will be implemented in a timely manner. Additionally, periodic in-depth inspections will be performed. These inspections should include, but are not limited to: housekeeping, implementation of tailgate meetings, employee training, employee exposure monitoring, project recordkeeping, accident investigation and recordkeeping, equipment maintenance and inspection, compliance with standard operating procedures, response to employee safety concerns, and specific hazard communication.

8.7 Hazard Communication Program and Labeling

A chemical inventory and MSDSs for chemical products that may be required during site operations will be maintained onsite, and will be updated by the SHSO as new chemicals are brought onsite. Employees will receive training in the safe handling of hazardous materials purchased for project activities. All chemical containers must remain labeled with the manufacturer's original label that describes the hazardous properties of the material. If the label is damaged during shipment and cannot be read, a new one must be obtained from the manufacturer. If chemicals are transferred to other containers, the second container must be labeled with the chemical product identity and primary hazards.

Section 9.0: GENERAL SITE SAFETY PROVISIONS

In general, Battelle will establish and maintain basic sanitation provision appropriate for the SOW for all employees in all places of employment including potable water and waste disposal in accordance with EM 385-1-1 Section 2 Sanitation. All onsite personnel are expected to conduct themselves in a professional manner. Appropriate conduct includes following established work rules, and supporting the safety of others. Violation of established work rules will result in disciplinary action, which may include verbal warning, written reprimand, and/or removal from the site.

9.1 General Site Health and Safety Work Rules

- All employees must complete the required training programs prior to starting work at the site.
- No consumption or possession of alcoholic beverages or illegal drugs will be allowed onsite. Anyone reporting to work under the influence of alcohol and/or illegal drugs will be subject to disciplinary action. Any employee under a physician's care and/or taking prescribed narcotics must notify the Field Team Leader.
- PPE is required in designated areas. Such equipment may include, but is not necessarily limited to: hardhat, safety glasses, steel-toed footwear, high-visibility garments, gloves, earplugs/earmuffs, protective face shields or splash goggles, and respiratory protection.
- Smoking is allowed only in designated areas. Eating, drinking, smoking, and the chewing of gum or tobacco are not allowed in the EZ.
- Changes in work practices or work rules will be implemented only after approval by the SHSO, SHER Representative and Field Team Leader.
- Construction equipment always has the right-of-way over regular vehicles.
- Employees must listen for warning signals on construction equipment and must yield to construction equipment at all times. When working around heavy equipment, employees shall routinely establish eye contact with the equipment operator so that they are certain that the operator has seen them and knows where they are.
- All equipment operators shall pay deliberate attention to workers on the ground that may be in their path, and provide these people with warning before moving the equipment.
- The wearing of seat belts in personal vehicles, trucks, and equipment is mandatory.
- All workers must follow emergency procedures and instructions from health and safety personnel explicitly.
- For any potentially hazardous compounds brought to the site, an MSDS will be provided and will be kept in an onsite binder.
- All workers will demonstrate proper etiquette at the Site. Workers will enter and depart the Site using routes designated by the Field Team Leader.

9.2 Conditions of Access to Exclusion Zones

- All personnel must meet the medical monitoring requirements described in this SHSP. Failure to submit to, or pass, any examination will be grounds for excluding the employee from the site.
- As required for site-specific work, employees must participate in an air quality exposure-monitoring program by wearing personal monitors or sampling devices designated by the SHSO. Any employee refusing to participate in the program, or tampering with a monitoring device or sample, will be subject to disciplinary action.
- No beards, goatees, or long sideburns will be allowed by personnel who will be using respiratory protection since they interfere with the seal of the respirator to the face. Trimmed sideburns and mustaches are acceptable. All employees who may be using respirators must report to work clean-shaven in any area of the face that comes in contact with the face-piece seal.
- All onsite personnel must wear the prescribed health and safety equipment, and go through specified decontamination procedures before exiting the EZ.
- Protective clothing to be worn inside the work zone will be supplied by the employee's respective employer. None of this clothing will be permitted to leave the site with any employee for personal use. Any equipment to be used elsewhere for another project will be fully decontaminated before it is removed from the site.
- Kneeling or sitting directly on the ground in the EZ is prohibited.
- All employees will utilize a buddy system while working on the site
- If necessary, a sign-in/out log will be kept to track personnel entering and leaving the EZ.

Section 10.0: EMPLOYEE TRAINING REQUIREMENTS

10.1 Visitors and Vendors

All visitors and vendors onsite must receive a briefing by the Field Team Leader or SHSO regarding the basic safety rules onsite, such as speed limit, work zones, and emergency procedures. This briefing is documented on the Tailgate Safety Meeting, included in Attachment 4 of the APP.

10.2 Exclusion Zones

All onsite personnel who may enter an EZ will be required to have the appropriate prior experience and training, in compliance with 29 CFR 1910.120 and 8 CCR 5192. Such training includes the 40-hour hazardous waste operations and emergency response basic training, 3 days of supervised field experience, 8-hour update training, and site-specific training. This training, according to the OSHA standard, must include the elements of spill response.

10.3 Site-Specific Training

All personnel performing work onsite will receive site-specific training, conducted by the Field Team Leader or SHSO and documented on the APP Acknowledgement form (Attachment 4 of the APP), prior to the initiation of onsite activities. This training will include:

- Review of this SHSP
- Key personnel and lines of authority
- Project activities and potential hazards
- Physical hazards onsite
- Chemical hazards
- Hazard Communication training for handling chemical products
- Work zones
- Training and medical monitoring requirements
- Site safety rules and conditions of access
- Required PPE
- Emergency response procedures and route to the hospital
- Hazard and accident reporting requirements
- Rights to access medical and exposure monitoring records.

A copy of the APP, including all attachments, will be maintained onsite at all times, and will be available to site employees. Documentation of this availability should be included with documentation of the training.

10.4 Hazard Communication Training

All personnel onsite who may be exposed to chemical hazards related to chemical products brought onsite will receive Hazard Communication training. This training will include a review of the chemical products and MSDSs, routes of exposure, potential physical and toxicological hazards, appropriate handling procedures, safe storage, labeling, and PPE.

10.5 Field Team Leader and SHSO

The Field Team Leader and SHSO must have completed the 10-hour OSHA Construction Safety training class within the last three years.

10.6 First Aid and Cardiopulmonary Resuscitation

At least two persons with current training and certification in first aid and CPR must be present onsite during field work. Refresher training in CPR is required every year, and every three years for first aid. The designated first aid/CPR individuals will also be trained in bloodborne pathogens. The various employers onsite may pool personnel to meet this requirement. The SHSO will coordinate any pooling efforts.

10.7 Tailgate Safety Meetings

Onsite tailgate meetings will be held before each workday to reinforce pertinent topics from the site-specific training, coordinate work activities, address task-specific hazards and protection levels, and anticipate problems that may arise during the day. Topics will include site-specific hazards, accident investigation results, air-monitoring and employee exposure monitoring results, and any specific employee concerns that may arise during the project.

The Field Team Leader, SHSO, or subcontractor's Field Team Leader will conduct these meetings for their respective crews. These meetings may be combined into a single meeting in order to aid coordination between the contractors. The SHSO will review and document the items discussed at the tailgate meeting. Attendance and the items discussed at the meeting will be documented (using appropriate safety forms provided in Attachment 4 of the APP) as part of the daily documentation for the site. The Field Team Leaders for the various employers will coordinate work activities on a daily basis.

Section 11.0: MEDICAL MONITORING

All personnel working in the EZ, with potential exposure to the site chemical hazards and/or utilizing respiratory protection will participate in a medical monitoring program appropriate to their work, in compliance with 29 CFR 1910.120/8 CCR 5192. Any site personnel or visitors who have not received medical clearance will be excluded from the EZ during the work. Employees not directly involved with the activities, and not likely to be exposed to site contaminants, are not subject to the medical monitoring requirements.

The monitoring program will consist of either a corporate annual physical examination or a pre-employment physical (if the employee was hired specifically for this job), performed by or under the direct supervision of a qualified physician who is board certified in occupational medicine. The content of these exams will be determined by the examining physician, and must meet the guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, as per 8 CCR 5192(f)(4)(B), .

For those employees who work infrequently in the EZ, i.e., site visitors and those needing only occasional access, the medical exam will be that which the examining physician determines is sufficient given the potential level of exposure.

All personnel wearing respiratory protection during any work onsite must have medical clearance to wear respirators, in accordance with 29 CFR 1910.134. The medical exam will be that which the examining physician determines is sufficient to provide clearance to use respiratory protection.

Post-project physical examinations will be conducted in light of actual site conditions and exposures. Additional monitoring may be required based upon initial results, employee symptoms, or physician request. Employee medical records shall be maintained to preserve their confidentiality. As required by 8 CCR 3204, Access to Medical and Exposure Records, employees shall have the right to access their personal records. Medical and exposure records will be managed in accordance with the provisions of Section 13.0, Documentation.

Section 12.0: EMERGENCY PROCEDURES

Potential onsite emergencies are expected to be restricted to fires, injuries to site personnel, or spills. Site conditions are generally expected to be within the limits of response measures which can be taken by onsite personnel. Any emergency that is life-threatening, or which poses a potential threat to the public, will be considered a situation requiring outside assistance from emergency response agencies. The Fire Department will provide first response support for fire, medical, and rescue emergencies. During any onsite emergency, work activities in the affected area will cease until the emergency is brought under control. Site workers will report incidents to the Field Team Leader, who will report them in turn to the client and the appropriate agencies. The emergency procedures described herein will be exercised prior to the start of on-site work and on-site on at least an annual basis, and then will be critiqued for lessons learned.

12.1 Emergency Response Assignments

The Field Team Leader/SHSO will function as the Response Coordinator for emergency operations at the site. He will function as the initial site contact for response teams arriving at the site. The Response Coordinator will assign additional roles during the emergency, as needed.

12.2 Emergency Reporting and Communications

Site personnel must report all incidents to their Field Team Leader immediately. The Field Team Leader will assure the appropriate notifications are made. If the Field Team Leader is not immediately available in emergency situations, site personnel may contact outside responders directly.

Table 1 contains the site emergency telephone numbers, and Figure 1 contains the route to the hospital with written directions. This information will be maintained in the site trailer and in all site vehicles. The accuracy of the telephone numbers will be verified prior to site activities. All personnel working onsite will be informed of these emergency numbers and emergency routes, and will also be informed of evacuation routes, meeting places, and evacuation warning signals in case of the need for an evacuation.

Normal onsite communications will consist of verbal communication and cellular telephones. The Field Team Leader will provide telephone notification to local response agencies and designated client and other agency contacts. After notifying local agencies, an individual will be assigned who will wait at the project entrance to provide initial information regarding the nature of the emergency and direct response teams to the Response Coordinator. The Field Team Leader will assure that the appropriate notifications are made to the client representative. Any spill will be reported to the client immediately.

Local (site) evacuations will be signaled by site personnel verbally or through repeated three long blasts of vehicle or equipment horns. The base-wide emergency signal will be three to five minutes of a steady tone or siren, followed by public address.

12.3 Emergency Equipment

Emergency equipment available onsite, to be used only by trained personnel, will consist of:

- First aid kit will be located onsite and its location will be discussed in the daily tailgate safety meeting

- Fire extinguishers shall be available in each Field team Leader vehicle, on each piece of heavy equipment, and immediately available to all fueling operations. Fire extinguishers shall receive a full inspection annually by a qualified service technician, and a visual inspection monthly and during each job site inspection. Fire extinguishers will be re-charged as necessary by a qualified service technician.
- An eyewash station that meets the criteria of ANSI standard Z-358.1-2004 or later and EM 385-1-1, will be available onsite and located within immediate use of areas with injurious substances, such as during handling of the sodium persulfate, fueling areas, and the EZ.
- Spill control materials will be immediately available to all chemical and waste handling areas. These materials will include the appropriate absorbent pads for the materials, noncombustible granular absorbent material, polyethylene sheeting, DOT-approved drums/containers, shovels and assorted hand tools, and the appropriate PPE.

12.4 Employee Injury or Illness

If an employee is injured or becomes ill, they shall be removed from the work area if it can be done safely and without aggravating medical conditions. An injured individual should be moved only under the following circumstances:

- When there is immediate danger (e.g., risk of fire/explosion, lack of oxygen, collapsing structure)
- When the location of the individual is obstructing co-workers or emergency personnel from caring for another individual who needs immediate attention
- When the movement is necessary to administer proper care (e.g., transfer of the individual to a firm, flat surface for CPR).

Only individuals currently trained in first aid and CPR shall render this type of assistance. At least two persons with current training and certification in first aid, CPR, and bloodborne pathogens will be present onsite all times. Personnel designated to provide first aid to injured workers will receive training and information for bloodborne pathogens. Potentially affected individuals will be advised of the hazards and modes of transmission of bloodborne pathogens and offered the option of receiving a Hepatitis B vaccination series. The site first-aid kit(s) will be outfitted with universal precaution protective gear for prevention of exposure to bloodborne pathogens during treatment of injured workers. Any items which come in contact with blood or other body fluids will be "red bagged" and disposed as medical waste. Each employer having designated first aid responders onsite must maintain its own Blood borne Pathogens Exposure Control Plan.

Injuries requiring more than first aid will be transported to the medical facility designated in Table 1 of the APP. Depending on the nature of the injury, site personnel may be transported in site vehicles or by ambulance. All life-threatening injuries will require contacting emergency responders and transport by ambulance.

Directions to the designated medical facility nearest the work location are included in Figure 2 of the APP. This Figure will be kept in site vehicles that may be used to transport injured personnel. The list of the emergency telephone numbers included in Table 1 of the APP will also be kept in site vehicles.

Personnel injured onsite who have been exposed to chemical hazards will be decontaminated prior to transport to the medical facility, to the extent possible without further compromising the health and safety of the injured individual, otherwise decontamination at the medical facility will be required. Emergency employee decontamination should consist of removing protective clothing and washing with soap and water as necessary. If necessary, protective clothing should be cut away to minimize injury to the injured person.

12.5 Chemical Exposures

The following procedures should be initiated as soon as possible in response to chemical exposures:

- For eye exposure, check for and remove any contact lenses. Wash the victim's eyes immediately at the emergency eyewash station using large amounts of water and lifting the lower and upper eyelids occasionally. Obtain medical attention if irritation persists.
- For skin exposure, remove any contaminated clothing and wash the contaminated skin areas promptly using soap or mild detergent (for site contaminants), and copious amounts of water. Obtain medical attention immediately if there are symptoms of chemical exposure (e.g., redness, blistering, or ulceration of the skin).
- For inhalation exposure, move the person to an area with clean air immediately (unless the scene is determined to be unsafe, or other injuries make moving the victim unadvisable). Keep the affected individual warm and at rest. If victim has stopped breathing, provide CPR and obtain medical attention immediately.
- For ingestion, contact the National Poison Control Center regarding the emergency response procedures specific to the ingested chemical. Obtain medical attention immediately if directed to do so by the Poison Control Center.

12.6 Fires

Reduction of fire risk will be accomplished through proper monitoring of the work areas, proper work procedures, good housekeeping, and through the maintenance onsite of adequate fire extinguishers. Site personnel will not engage in fire fighting activities beyond the incipient stage. The Fire Department listed in Table 1 of the APP will be called for any fire event. If a fire requires more than one fire extinguisher, site personnel will evacuate the area and wait for the fire department to respond.

12.7 Spills

The appropriate measures will be taken to prevent spills during handling of liquids. If possible, drums and other liquid storage will be staged such that a spill in the vicinity of a storm water drain is avoided. Any spill of contaminated soil, fuel, chemicals, or groundwater will require immediate response and cleanup. Personnel handling contaminated materials shall be current in the training specified in this SHSP, which for personnel entering the EZ includes 40-hour Hazardous Waste Operations training, which according to the OSHA standard must include the elements of spill response. Battelle's Guidelines for Emergency Response Actions (Attachment 4 to the APP) will be followed during spill events. For all spill events, the area will be secured, and the appropriate notifications made to the Fire Department, Navy RPM, and Navy ROICC. An assessment will be made of the magnitude and potential impact of the release. As such and if it is safe to do so, site personnel will attempt to locate the source of the release, prevent further release, and contain the spilled materials as follows:

- The spill area will be approached cautiously; air monitoring instruments will be used to assess breathing zone hazards during spill response activities. Hazards will be identified based on available information from witnesses to determine the proper personal protection levels, methods, and equipment necessary for the response.
- Control of the spill at the source by shutting off pumps, plugging or closing valves, righting containers or drums, or transferring contents of leaking tanks or drums will be implemented immediately.
- Dry oxidant may be swept up using compatible equipment and stored in suitable containers. Oxidant solutions may be neutralized as per manufacturer's recommendations.
- Spills or surfacing of oxidant solution will be prevented from entering the bay and will be allowed to soak into the soil. Surface residue will be diluted with additional water.
- If fuel is spilled, a 50-foot-radius rule will be imposed, and all sources of ignition will be eliminated.
- If possible, spill containment will initially be made without entering the immediate release area.
- Spill containment and collection will be performed by using absorbent materials and by construction of temporary dikes.
- Liquids will be containerized for appropriate disposal.

12.8 Site Evacuation

Potential reasons for site evacuation include earthquakes, fires or explosions. In the unlikely event of site evacuation, verbal notification or repeated three long blasts on a vehicle or equipment horn will be used to sound the alarm. Employees will report to the Field Team Leader's vehicle without delay, where the Field Team Leader will conduct a head count and establish the proper means and route of evacuation to the base gathering point, indicated on Figure 3 of the APP. The Field Team Leader or SHSO will notify emergency personnel as soon as possible once all field team personnel are accounted for. If appropriate and safe, the Field Team Leader and a "buddy" should remain near the site after the site has been evacuated to assist local responders and advise them of the nature of the incident.

12.9 Accident Follow-Up

Accident follow-up will be performed in accordance with Battelle's Corporate Health & Safety Program. Immediately following serious accidents, the appropriate notifications will be made to the appropriate agency (e.g., OSHA for serious injuries, National Response Center for releases, etc.). In all cases, the appropriate client notifications will be made. Accidents and investigations will be documented on the Incident Analysis form in Attachment 4 of the APP, and on the Navy Contractor Serious Incident Report (CSIR) form in Attachment 5 of the APP, as required. Following all accidents and near-misses, an investigation will be initiated by the SHSO and Field Team Leader, in coordination with the SHER Representative. The focus of all investigations will be to collect accurate information, to discern the underlying causes of the accident, to implement appropriate control measures to prevent future accidents, and to critique and improve emergency response. All corrective actions will be tracked, and publicized to all affected employees.

Table 1. Emergency Telephone Numbers

Contact Phone	Number
Emergency (Alameda Police, Fire, Ambulance)	911*
Hospital: Alameda Hospital 2070 Clinton Avenue, Alameda, CA	General: (510) 522-3700 Or (510) 523-4357
Steve Rosansky Battelle Project Manager	(614) 424-7289
Derek Payne Battelle Field Team Leader/Site Health and Safety Officer	Office: (619) 574-4822 Cell: (760) 427-8013
Bernard Himmelsbach Battelle Safety, Health and Emergency Response Representative	(614) 424-4302
Brant Smith XDD Project Manager	Office: (603) 778-1100
Heather Wochnick Navy Remedial Project Manager	Office: (619) 532-0763
Gregory Grace Navy Resident Officer In Charge of Construction, SF Bay	Office: (510) 749-5940
Bob Perricone Navy Alternate Contact	Office: (510) 749-5939
Doug Delong Navy Caretaker Site Office	Office: (415) 743-4713 Cell: (510) 772-8832

*Note: If calling from a cell phone, calls to 911 will reach California Highway Patrol. Caller will need to give location and ask for Alameda emergency response.

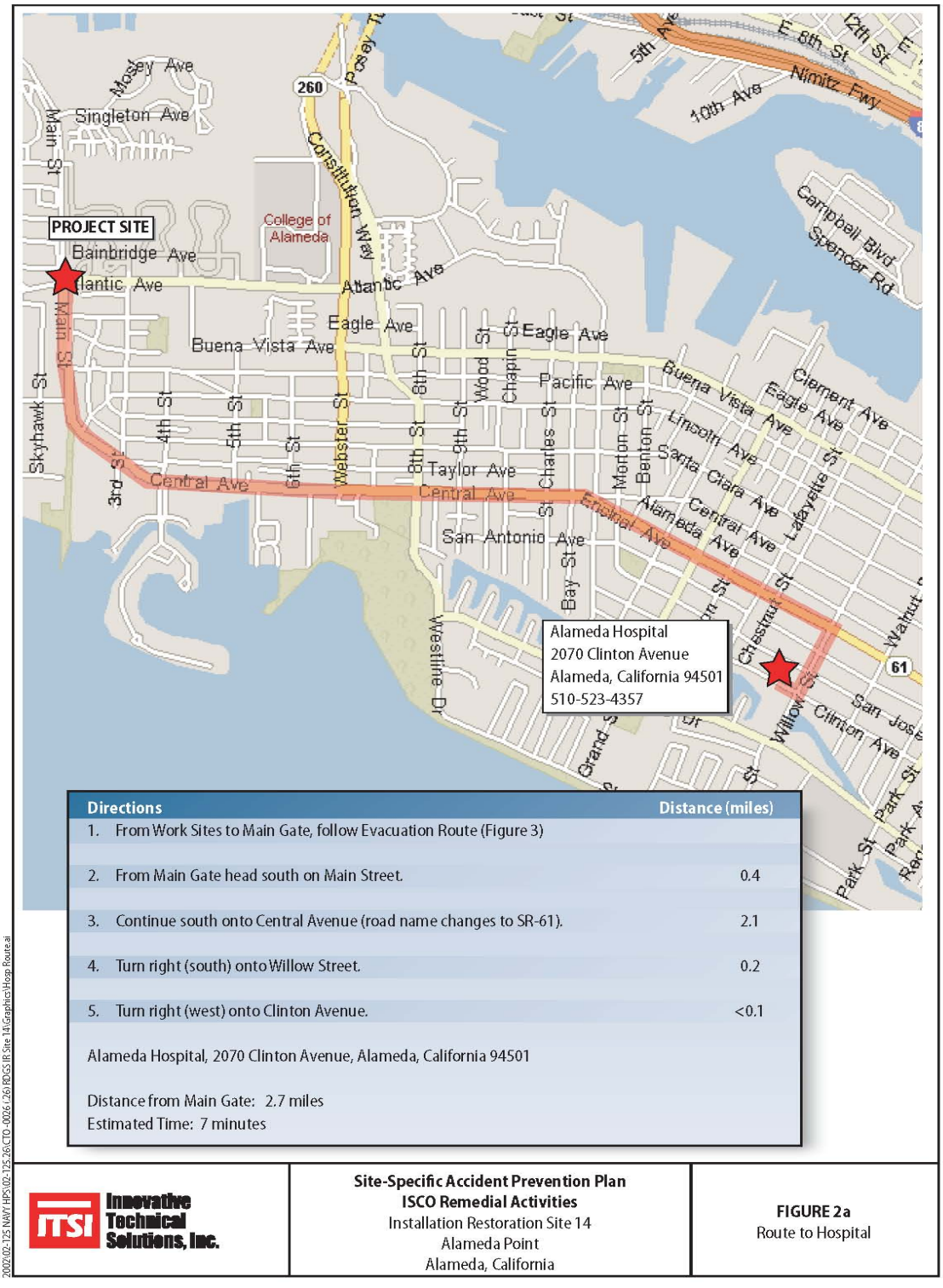

Figure 1. Hospital Route Map

Section 13.0: DOCUMENTATION

13.1 Types of Documentation

Health and safety-related documents will be maintained onsite by the SHSO and at Battelle. These documents include, but are not limited to:

- SHSP
- Site safety inspections
- Truck and heavy equipment inspections
- APP acknowledgements
- Tailgate safety meetings
- Employee training and medical clearance (non-confidential) records
- Instrument calibration records
- Air monitoring records and documentation of employee exposures
- Accident or incident reports and investigations
- MSDSs for chemical products used onsite

13.2 Postings and Signs

The following information will be posted and/or maintained by the Field Team Leader or SHSO, as a minimum:

- Emergency phone numbers and evacuation routes
- OSHA poster
- Federal and State labor law posters
- Federal contracting posters

Warning signs will be utilized to warn personnel of work zones, special hazards, and PPE requirements. These notices will be posted in English and, if appropriate, in any other language necessary for all workers and visitors to clearly understand.

13.3 Records Management

All safety-related records generated for the project will be reviewed for completeness and accuracy by the SHSO, and may be audited by the SHER Representative. All equipment inspections will be tracked for completeness by the Field team Leader or SHSO on a daily basis.

All onsite personnel will be required to provide documentation of their training and medical monitoring to the SHSO before they begin to work at the site. Documentation must include (as appropriate):

- 40-hour hazardous waste training
- Most recent 8-hour refresher for hazardous waste
- Most recent medical examination, including clearance to wear respiratory protection (as appropriate)
- Most recent respirator fit test (as appropriate)

The SHSO and Field team Leaders must also provide documentation of the following, as appropriate:

- 8-hour supervisory course for hazardous waste
- 10-hour OSHA Construction Safety training

Permanent medical records are maintained in confidential files by the respective contract physicians and/or medical clinics. The examining physician must supply the employing company with a medical status document certifying that the individual examined is physically capable of performing his/her individual work tasks and of wearing respiratory protective devices (as appropriate). These certifications are maintained in confidence at the company's offices. Medical records for each employee shall be preserved and maintained for at least the duration of employment plus thirty (30) years.

Each employee exposure record shall be preserved and maintained for at least thirty (30) years and must contain the collection methodology (sampling plan), a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results, including a correlation of the employee name, social security number, and job classification with the calculated or monitored exposure levels.

ATTACHMENT 2

OSHA 300A FORMS (2 YEARS)

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2007

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	2	2	13
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
125	29
(K)	(L)

Injury and Illness Types

Total number of...	(M)		
(1) Injury	16	(4) Poisoning	0
(2) Skin Disorder	1	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	0

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Establishment information

Your establishment name: Battelle Columbus Labs

Street: 1425 Plain City - Georgesville Road

City: West Jefferson State: Ohio Zip: 43162

Industry description (e.g., Manufacture of motor truck trailers)
Research and Development

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

OR North American Industrial Classification (NAICS), if known (e.g., 336212)
5 4 1 7 0

Employment information

Annual average number of employees: 319

Total hours worked by all employees last year: 638,000

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Carol F Kohut
Company executive

President & CEO
Title

614-424-6562
Phone

Jan 27, 2008
Date

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 2007

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	2	3	13
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
65	64
(K)	(L)

Injury and Illness Types

Total number of...	(M)		(M)
(1) Injury	17	(4) Poisoning	0
(2) Skin Disorder	0	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	1

Establishment information

Your establishment name: Battelle Columbus Labs

Street: 505 King Avenue

City: Columbus State: Ohio Zip: 43201

Industry description (e.g., Manufacture of motor truck trailers)
Research and Development

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

OR North American Industrial Classification (NAICS), if known (e.g., 336212)
5 4 1 7 0

Employment information

Annual average number of employees: 2329

Total hours worked by all employees last year: 4,658,000

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Carl F Kohrt — Company executive

President & CEO — Title

614-424-6562 — Phone

Jan 26, 2008 — Date

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

ATTACHMENT 3

ACTIVITY HAZARD ANALYSIS

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(1) MOBILIZATION		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Mobilization/ Site Set-Up	Struck by equipment	All equipment, augers, rods and tools will be properly secured during transport.
	Unstable drill rig	Never move the drilling rig with the mast upright. Set hydraulic leveling jacks before raising the mast. Never place outriggers over manhole covers, vaults, storm drains, grates, etc. Never place outriggers on soft or yielding ground surfaces.
	Backing up equipment	Use a ground guide along with a functioning back-up alarm (if available) during equipment backing.
	Electrocution	Inspect for buried and overhead utilities in the vicinity of the drilling location. All extension cords shall be rated "hard usage" or "extra hard usage" per EM 385-1-1, which will be available upon request. Patched, oil soaked, worn, or frayed electrical cords or cables shall not be used.
	Pinch points	Avoid placing hands close to moving machinery. Ensure all machine guards are in place. Wear appropriate PPE, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part).
	Use of power tools	All recommended controls & actions that apply to power equipment also apply to hand tools. Inspect power cords for wear and damage. Do not use equipment with damaged cords. Use GFCI on extension cords when working outside or in wet environments. Wear gloves when practical. Wear safety glasses with side shields.
	Slips, trips, falls	Clear all ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools	Pre/Post maintenance Visual prior to use	Tailgate safety meeting Site specific orientation Hazard observation and communication

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(2) SCAN, LOCATE, AND MARK UTILITIES		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Park contractor vehicle at site.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard	Locate vehicle in an area that will not obstruct traffic. Use appropriate traffic signs when necessary in order to alleviate any traffic hazards.
2. Unload equipment from vehicle.	Lifting of instruments from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
3. Move equipment to designated survey location.	Handling of instruments could cause strain to worker.	Carry instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Slip, trip, and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Openings 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
4. Survey and mark utilities.	Worker could be struck by vehicle.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when surveyor is using instruments (a surveyor is often focused on the task and may not be aware of nearby traffic). Use traffic controls or barricades, if necessary, to keep traffic away from workers.
	Use of spray paint to mark underground utilities and anomalies could expose employees to paint fumes or paint itself.	Follow manufacturers' instructions on use of paint. Review Material Safety Data Sheets (MSDSs). Never point spray paint canisters at another person.
	Incorrect utilities marking could create unknown hazards.	Use following universal color codes for utilities: Blue – Water; Red – Electrical; Yellow – Gas; Green – Sewer. Orange – Communications. See American Public Works Association Utility Location & Coordination Council Uniform Color Code

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(2) SCAN, LOCATE, AND MARK UTILITIES		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
4. Survey and mark utilities. (Continued)	When carrying stakes, worker could trip and impale body.	Carry stakes in leather or canvas bag that is puncture-proof, and carry bag to side of body. Ensure that all tips are pointed toward ground at all times.
	Installations of wooden stakes present puncture and splinter hazards.	Keep stake tip pointed at ground. Wear appropriate PPE. Use caution when using tools to pound stake in.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
Hand tools Stakes Spray Paint Utility Locator Equipment	Pre/Post maintenance Visual prior to use	Tailgate safety meeting Site specific orientation Hazard observation and communication

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(3) MONITORING WELL INSTALLATION		
Prepared by: Sarah McCall **Date: 03/21/08** **Reviewed by: Steve Rosansky** **Date: 11/24/08**		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
1. Park contractor vehicle carrying drill rig and equipment.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic. Use appropriate traffic signs when necessary in order to alleviate any traffic hazards.
2. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. Evaluate load carefully and determine the most appropriate methods in which the load can be safely removed.
	Lifting equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Cuts and abrasions could occur while moving equipment and materials.	Use caution and wear the appropriate PPE when moving objects with sharp contact points.
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Opening 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
3. Inspect drill rig and surrounding area.	Improper inspection of rig and surrounding area could result in an unstable drilling environment and could cause workers to be exposed to hazards associated with operation mechanical devices.	Ensure that rig and all associated equipment are inspected by a competent person and that rig is in safe operating condition, in accordance with EM 385-1-1. Inspect equipment; including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Tag and remove from service faulty or unsafe equipment.
		Prior to drilling, perform adequate site clearing and leveling to accommodate the drill rig and supplies and provide a safe working area. Drilling shall not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions. Operator's manual must be available and reviewed prior to operation.
		Ensure that requirements of EM 385-1-1, which will be available upon request, Section 16.M, are being followed (e.g., ensure at least two emergency shut off switches are functioning properly, install cage guard to enclose turning augers, and workers will not wear loose clothing,

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(3) MONITORING WELL INSTALLATION		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
		dangling jewelry or long hair).
3. Inspect drill rig and surrounding area. (Continued)	Improperly Stored Materials or Supplies.	Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor. Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig. Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding. Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use. Work areas, platforms, walkways, scaffolding and other access ways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous. Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice. Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.
4. Hand-auger first 5 feet of each boring.	Hand-augering, digging, or post-holing could cause injury to lower back.	Bend knees and use proper posture and back support while hand-augering, digging, or post-holing boring location. If hand augering, bend knees and use two people, if necessary, to remove auger from hole. If post-holing, ensure that area is clear before striking ground with pike used to break up ground surface.
	Hand-augering, digging, or post-holing over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during hand-augering to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching or pressing.
	Slip, trip, and fall hazards could be present due to boreholes.	Protect all open boreholes as any open excavation if left unattended (on this project, all boreholes should be filled before end of day).
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark drilling sites for visibility. If necessary, perform traffic controls.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE. Remove PPE properly and wash hands.

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(3) MONITORING WELL INSTALLATION		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
5. Position and set up drill rig and associated equipment.	Electrocution, damage to underground utilities, or tipping rig over in unstable soil conditions is possible.	Do not move drill rig into any work area until a site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss the site layout plan and analysis of route of travel, along with AHAs. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Ensure that the drill rig is equipped with an operational emergency shutdown mechanism. Do not place rig within 15 feet of any overhead electrical lines. When hand-augering location, ensure that hand-augered area is equal to outside diameter of auger used to advance boring, if applicable. Use a spotter for positioning as necessary.
	Off-road movement.	Before moving a drill rig, walk the route of travel and inspect for any obstacles. Always check the brakes of a drill rig carrier before traveling. Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings. When possible, travel directly uphill or downhill. Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle. Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close. After the drill has been moved to a new drilling site, set all brakes and/or locks. Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.
	Vehicle could move if not properly set up.	Extend stabilizer jacks and ensure footing is sound. Use a spotter to properly position vehicle place wheels or stabilizer jacks; do place wheels or stabilizer jacks over manholes, vault box lids, etc. Set brakes and place wheel chock under front wheels of mobile rig. Ensure that the vehicle is level in both the vertical and horizontal planes.
	Rig could contact overhead lines or structures when the mast is raised or if the rig is transported with the mast raised.	Overhead space will be visually cleared prior to raising the mast and a spotter will be used while the mast is being raised. Never move rig when mast is extended.
	Worker could become pinned between rig and other truck components, or worker could be pinned under rig if rig is serviced from under truck.	When any part of rig or equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under rig or truck while rig is supported by lifting jacks. If work must be done under rig or truck, the drill crew supervisor must contact the SHSO to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.

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Prepared by: Sarah McCall **Date: 03/21/08** **Reviewed by: Steve Rosansky** **Date: 11/24/08**		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
	High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Do not operate rig if winds exceed manufacturer's recommended tolerances.
5. Position and set up drill rig and associated equipment (continued).	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear appropriate PPE, as appropriate. Ensure that any of the machine guarding is in place.
	Electrocutions, explosions, etc. could occur and cause impact to utilities and life.	Obtain and examine copies of all pertinent drawings prior to performing this task. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Inspect the area of drilling activity for overhead obstructions. Contact service facility engineer before working near utilities. Ensure that weight of rig is evenly distributed on ground and is not so heavy as to damage any underground lines that may be near the surface (e.g., shallow, buried PVC lines).
6. Start up rig and perform drilling.	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Ensure that personnel are trained in use of drilling equipment. Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that first aid kit is readily available to treat injured workers. Ensure that a 20 pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill control kit is available at the drilling location. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. Use safety clamps (whip checks) to connect each side of connection to other if connection breaks (safety clamps will keep hoses from whipping under sudden release of pressure). Tie back or attach hoses wherever possible to minimize length of hose that could whip around if a rupture occurs.

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Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
	Worker could be exposed to chemical agents.	Verify selection of PPE with ambient air/visual monitoring. Review all MSDSs. Decontaminate drilling implements after use (or cover contaminated parts when moving to the next drilling site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all soil cuttings. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as specified in the SHSP.
6. Start up rig and perform drilling. (Continued)	Worker could be exposed to chemical agents.	Verify selection of PPE with ambient air/visual monitoring. Review all MSDSs. Decontaminate drilling implements after use (or cover contaminated parts when moving to the next drilling site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all soil cuttings. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as specified in the SHSP.
	Electrification of the drill rig.	Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig. If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang onto the vehicle or any part of the drill when jumping clear. If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.
	Injury as result of rotating augers.	The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation. Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform. Never allow feet to get under the auger section that is being hoisted. When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or

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Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
		around a rotating auger for any reason whatever. Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger. Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating. Ensure that there are at least two ready available Emergency Shutoff switches. Ensure that all Emergency Shutoff switches function properly. Install cage guard to enclose turning augers. Workers shall not wear loose clothing, dangling jewelry or long hair.
6. Start up rig and perform drilling. (Continued)	Workers could place hands into moving parts of rig, or loose clothing could become entangled in moving machine parts, either of which could injure worker.	Guard all chains, sprockets, and moving parts. Do not wear loose clothing or any jewelry. Ensure that operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment.
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Ensure appropriate guards are in place.
7. Mix grout.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could come into contact with grout.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands. Avoid generating dust. Review MSDS for grout.
8. Pour grout into borehole to seal.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could come into contact with grout.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.
	Grout could cause probe rods to be slippery.	Wear gloves, as appropriate. Use extra caution while removing and handling rods.
9. Finish boring at surface with concrete.	Worker could come into contact with concrete.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.

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(3) MONITORING WELL INSTALLATION		
Prepared by: Sarah McCall **Date: 03/21/08** **Reviewed by: Steve Rosansky** **Date: 11/24/08**		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
Drilling rig, hand tools, and power tools	Daily or before use. Use inspection checklist. Complete form and sign. A drill rig operators' manual must be available at the job site.	Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicle-licensed personnel will operate trucks. All drillers and drillers' helpers must have documented training on use of rig.

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(4) Chemical Oxidation Remediation		
Prepared by: Sarah McCall **Date: 03/21/08**	**Reviewed by: Steve Rosansky** **Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Park contractor vehicle carrying drill rig and equipment.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic. Use appropriate traffic signs when necessary in order to alleviate any traffic hazards.
2. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. Evaluate load carefully and determine the most appropriate methods in which the load can be safely removed.
	Lifting equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Cuts and abrasions could occur while moving equipment and materials.	Use caution and wear the appropriate PPE when moving objects with sharp contact points.
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Opening 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
3. Inspect drill rig and surrounding area.	Improper inspection of rig and surrounding area could result in an unstable drilling environment and could cause workers to be exposed to hazards associated with operation mechanical devices.	Ensure that rig and all associated equipment are inspected by a competent person and that rig is in safe operating condition, in accordance with EM 385-1-1. Inspect equipment; including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Tag and remove from service faulty or unsafe equipment. Verify that emergency shutdown system is clearly marked, and location is known by all site workers. Verify that the emergency shutdown system is well marked and consists of a minimum of two kill switches- one for the driller and one for the driller's helper. Ensure that the kill switch shuts down the system when the switch is pushed or pulled.
		Prior to drilling, perform adequate site clearing and leveling to accommodate the drill rig and supplies and provide a safe working area. Drilling shall not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions. Operator's manual must be available and reviewed prior

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Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**	
		to operation.	
3. Inspect drill rig and surrounding area. (continued)	Improper inspection of rig and surrounding area could result in an unstable drilling environment and could cause workers to be exposed to hazards associated with operation mechanical devices. (continued)	Ensure that requirements of EM 385-1-1, Section 16.M, are being followed (e.g., ensure at least two emergency shut off switches are functioning properly, install cage guard to enclose turning augers, and workers will not wear loose clothing, dangling jewelry or long hair).	
	Improperly Stored Materials or Supplies.	Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor. Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig. Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding. Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use. Work areas, platforms, walkways, scaffolding and other access ways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous. Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice. Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.	
4. Hand-auger first 5 feet of each boring.	Hand-augering, digging, or post-holing could cause injury to lower back.	Bend knees and use proper posture and back support while hand-augering, digging, or post-holing boring location. If hand augering, bend knees and use two people, if necessary, to remove auger from hole. If post-holing, ensure that area is clear before striking ground with pike used to break up ground surface.	
	Hand-augering, digging, or post-holing over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during hand-augering to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching or pressing.	
	Slip, trip, and fall hazards could be present due to	Protect all open boreholes as any open excavation if left unattended (on this project, all boreholes should be filled before end of day).	

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(4) Chemical Oxidation Remediation			
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Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**	
	boreholes.		
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark drilling sites for visibility. If necessary, perform traffic controls.	
4. Hand-auger first 5 feet of each boring. (Continued)	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE. Remove PPE properly and wash hands.	
5. Position and set up drill rig and associated equipment.	Electrocution, damage to underground utilities, or tipping rig over in unstable soil conditions is possible.	Do not move drill rig into any work area until a site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss the site layout plan and analysis of route of travel, along with AHAs. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Ensure that the drill rig is equipped with an operational emergency shutdown mechanism. Do not place rig within 15 feet of any overhead electrical lines. When hand-augering location, ensure that hand-augered area is equal to outside diameter of auger used to advance boring, if applicable. Use a spotter for positioning as necessary.	
	Off-road movement.	Before moving a drill rig, walk the route of travel and inspect for any obstacles. Always check the brakes of a drill rig carrier before traveling. Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings. When possible, travel directly uphill or downhill. Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle. Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close. After the drill has been moved to a new drilling site, set all brakes and/or locks. Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.	
	Vehicle could move if not properly set up.	Extend stabilizer jacks and ensure footing is sound. Use a spotter to properly position vehicle place wheels or stabilizer jacks; do place wheels or stabilizer jacks over manholes, vault box lids, etc. Set brakes and place wheel chock under front wheels of mobile rig. Ensure that the vehicle is level in both the vertical and horizontal planes.	

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(4) Chemical Oxidation Remediation		
Prepared by: Sarah McCall **Date: 03/21/08**	**Reviewed by: Steve Rosansky** **Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
	Rig could contact overhead lines or structures when the mast is raised or if the rig is transported with the mast raised.	Overhead space will be visually cleared prior to raising the mast and a spotter will be used while the mast is being raised. Never move rig when mast is extended.
	Worker could become pinned between rig and other truck components, or worker could be pinned under rig if rig is serviced from under truck.	When any part of rig or equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under rig or truck while rig is supported by lifting jacks. If work must be done under rig or truck, the drill crew supervisor must contact the SHSO to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.
5. Position and set up drill rig and associated equipment. (Continued)	High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Do not operate rig if winds exceed manufacturer's recommended tolerances.
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Ensure that any machine guarding is in place. Wear appropriate PPE.
	Electrocutions, explosions, etc. could occur and cause impact to utilities and life.	Obtain and examine copies of all pertinent drawings prior to performing this task. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Inspect the area of drilling activity for overhead obstructions. Contact service facility engineer before working near utilities. Ensure that weight of rig is evenly distributed on ground and is not so heavy as to damage any underground lines that may be near the surface (e.g., shallow, buried PVC lines).

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Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**	
6. Start up rig and perform drilling.	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Ensure that personnel are trained in use of drilling equipment. Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that first aid kit is readily available to treat injured workers. Ensure that a 20 pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill control kit is available at the drilling location. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.	
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. Use safety clamps (whip checks) to connect each side of connection to other if connection breaks (safety clamps will keep hoses from whipping under sudden release of pressure). Tie back or attach hoses wherever possible to minimize length of hose that could whip around if a rupture occurs.	
	Worker could be exposed to chemical agents.	Verify selection of PPE with ambient air/visual monitoring. Review all MSDSs. Decontaminate drilling implements after use (or cover contaminated parts when moving to the next drilling site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all soil cuttings. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as approved by the SHSP.	

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Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**	
6. Start up rig and perform drilling. (Continued)	Electrification of the drill rig.	Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig. If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang onto the vehicle or any part of the drill when jumping clear. If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.	
	Injury as result of rotating augers.	The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation. Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform. Never allow feet to get under the auger section that is being hoisted. When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever. Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger. Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating. Ensure that there are at least two ready available Emergency Shutoff switches. Ensure that all Emergency Shutoff switches function properly. Install cage guard to enclose turning augers. Workers shall not wear loose clothing, dangling jewelry or long hair.	
	Workers could place hands into moving parts of rig, or loose clothing could become entangled in moving machine parts, either of which could injure worker.	Guard all chains, sprockets, and moving parts. Do not wear loose clothing or any jewelry. Ensure that operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment.	
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.	
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Keep constantly alert.	

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Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
7. Conduct In-situ Chemical Oxidation (ISCO) injection treatment.	Exposure to site constituents and groundwater treatment/remediation chemicals.	Limit access to exclusion zones to only trained and qualified personnel. Do not eat, drink, or smoke in exclusion zone (EZ). Wear the appropriate PPE which may include nitrile or neoprene gloves, safety goggles, steel-toed footwear, and Tyvek coveralls/aprons or assigned by the SHSO. Stay clear of pressurized lines, especially during pressurization. Follow decon procedures and wash hands and face upon exiting exclusion zone. Dispose of PPE appropriately, and store all waste materials and used PPE in approved containers to await appropriate disposal. Maintain good housekeeping, keep equipment clean. Work areas must be inspected at least once per shift by the SHSO. Maintain ANSI-rated eyewash in the support zone. Keep adequate stock of spill response equipment available.
	Exposure to Pressurized lines and hydraulic injection	Perform daily inspections of hoses and connections Assure that all pressurized hoses have safety restraints at connections. Disconnect and release air pressure from pneumatic tools prior to repairs or adjustments.
8. Mix grout.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could come into contact with grout.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands. Avoid generating dust. Review MSDS for grout.
9. Pour grout into borehole to seal.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could come into contact with grout.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands. Avoid generating dust. Review MSDS for grout.
	Grout could cause probe rods to be slippery.	Wear gloves, as appropriate. Use extra caution while removing rods and handling them, as they are prone to slip.
10. Finish boring at surface with concrete.	Worker could come into contact with concrete.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
a. Drilling equipment (direct-push rig)	a. A drill rig operators' manual must be	<u>Drillers</u>: All drillers and drillers' helpers must have documented

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(4) Chemical Oxidation Remediation			
Prepared by: Sarah McCall	**Date: 03/21/08**	**Reviewed by: Steve Rosansky**	**Date: 11/24/08**
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**	
	available at the job site. Pre-use and daily equipment inspections, especially of hoses and connections. Daily site inspections, using inspection checklist. Complete form and sign.	training on use of rig. Drill rigs may be operated only by designated and qualified personnel <u>Truck Operators</u>: Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicle-licensed personnel will operate trucks. <u>All On-site Personnel</u>: Site orientation Review of emergency procedures, including operation of drill rig shutoff switches Review of this AHA Hazwoper 40-hour training 8-hour annual refresher 8-hour supervisor's training, as appropriate Current medical exam Clearance to wear respirator, and fit test, as required Current fire extinguisher training Site Superintendent and SHSO must have OSHA-approved 10-hour Construction Safety training Daily tailgate meetings	
b. PID	b. Calibrate air monitoring equipment daily, prior to use Pre-use and daily equipment inspections, especially of hoses and connections.		
c. Chemical injection pumps	c. Pre-use and daily equipment inspections, especially of hoses and connections.		
d. Trucks, site vehicles	d. Daily site inspections, using inspection checklist. Complete form and sign. Pre-use and daily equipment inspections, especially of hoses and connections.		
e. Hand and power tools	e. Pre-use and daily equipment inspections, especially of hoses and connections.		
f. Safety equipment such as first aid kits, fire extinguishers, eyewashes, heat stress monitoring equipment	f. Pre-use and daily equipment inspections, especially of hoses and connections.		

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(5) WELL DEVELOPMENT		
Prepared by: Sarah McCall **Date: 03/21/08**	**Reviewed by: Steve Rosansky** **Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Purge well.	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools	Pre/Post maintenance Visual prior to use	Tailgate Safety Meeting Site specific orientation Hazardous waste operations Hazard observation and communication

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(6) EQUIPMENT DECONTAMINATION		
Prepared by: Sarah McCall Date: 03/21/08		**Reviewed by: Steve Rosansky Date: 11/24/08**
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear steel-toed footwear with good traction. Keep area dry and clean.
2. Pressure Washing/Steam Cleaning.	Establishing wash area with plastic sheeting and water collection could involve handling heavy and/or hazardous objects	Use mechanical assistance equipment whenever possible. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person. Lift with legs, keep loads close to body, don't twist while picking up loads and avoid awkward positions. Wear cut-resistant work gloves when working with sharp objects or knives/razor knives.
	Workers could suffer from heat stress, dehydration, sunburn, and/or cold stress.	Drink plenty of water, and electrolyte drinks as needed. Wear light-colored, cotton clothing in hot weather. Slow down work rate and increase breaks in hot weather. Keep an eye on co-workers for symptoms. If noticed, get to shade, open clothing, and give fluids if conscious. Contact 911 if heatstroke is suspected. Use sunscreen. In cold weather, minimize or avoid exposure to wind and rain and wear rain-resistant clothing as necessary. Provide place of refuge: shaded for hot weather, warm and dry in cold weather.
	Cuts and burns from high-pressure and/or high-temperature spray are possible.	Use PPE, including safety glasses, face-shields, heavy gloves, and metatarsal guards. Never point sprayer at any body part. Also do not use to clean personnel.
	Workers could be exposed to chemicals on equipment being cleaned.	Limit access to washing area to only trained and qualified personnel. Protect areas from overspray. Do not eat, drink, or smoke in the decontamination area. Wear the appropriate PPE, including gloves, safety glasses and face shield, overalls, and steel-toed footwear. Follow decontamination procedures and wash hands upon exiting area. Store all waste materials and used PPE in approved containers to await appropriate disposal. Maintain good housekeeping and keep equipment clean. Maintain ANSI-rated eyewash in support zone. Review MSDSs for chemicals used. Follow safe work procedures for fire hazards of fuels.

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(6) EQUIPMENT DECONTAMINATION		
Prepared by: Sarah McCall Date: 03/21/08		**Reviewed by: Steve Rosansky Date: 11/24/08**
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
2. Pressure Washing/Steam Cleaning. (Continued)	Workers and surrounding personnel could be exposed to high noise levels.	Stand away from operating equipment whenever possible. Wear ear plugs/ear muffs when conversation is difficult at an arm's length.
3. Fueling.	Fire hazards could exist during any fueling	Smoke only in designated areas, and never during fueling. Keep charged fire extinguishers accessible near work. Use only DOT-approved fuel storage cans. Do not fill gasoline cans in the back of pickup trucks. Fuel equipment away from brushy areas. Shut down equipment during fueling. Clean up spills promptly. Keep supplies of PPE and absorbent readily available. Always work within your training and equipment limitations during spills.
4. Transferring and storing field generated wastes pending analysis.	Exposure to site contaminants or /materials.	Wear the appropriate PPE, which may include gloves, safety glasses and face-shield, coveralls/aprons, steel-toed footwear, and metatarsal guards. Follow decontamination procedures and wash hands upon exiting area. Store all waste materials and used PPE in approved containers to await appropriate disposal. Maintain good housekeeping, and keep equipment clean. Work areas must be inspected at least once per shift by the SHSO. Maintain ANSI-rated eyewash in support zone.
	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
Pressure washing/steam cleaning equipment Pump Hand and power tools Safety equipment such as first aid kits, fire extinguishers, eyewashes, heat stress monitoring equipment PPE	<u>All Equipment Requires</u>: Pre/Post maintenance inspections Pre-use and daily equipment inspections	<u>All On-Site Personnel</u>: Tailgate safety meeting Site specific orientation Hazardous waste operations Hazard observation and communication LO/TO Review of this AHA Hazwoper 40-hour training 8-hour annual refresher 8-hour supervisor's training, as appropriate Current medical exam Clearance to wear respirator, and fit test, as required

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(7) IDW REMOVAL AND DISPOSAL		
Prepared by: Sarah McCall Date: 03/21/08	**Reviewed by: Steve Rosansky Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
1. Place/pour waste into containers (e.g., 55-gallon drum, roll-off bin, etc.).	Lifting of wastes could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE. Decontaminate exteriors of tools or buckets used to transport wastes to containers. Avoid spills. Ensure spill cleanup supplies are available.
2. Load drums onto vehicles.	Handling of drums can expose worker to injury (including, but not limited to, strains, lacerations, and pinch points).	Ensure drums are individually properly labeled and that labels are visible when drums are placed on truck. Use truck that has "Tommy Lift" and move drum using drum dolly onto lift. Ensure that drum is secure and will not roll when lift is raised. Wheel drum to appropriate location on truck for transport. Be sure to evenly distribute load weight on bed of truck. Secure drums in place on the truck. If drums are loaded with drum handling device attached to heavy equipment, stand away from truck when drum is placed onto truck. Once drum is placed and "loader" moves away from truck, use drum dolly on truck to position drum. Avoid placing pallets of drums on truck unless pallets can be positioned where they will remain for transport.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when loading drums close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
3. Transport drums to temporary storage location.	Drums may leak.	Inspect all drums prior to and following transport. Have spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work steel-toed footwear with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.
	Handling of drums can expose to injury (including, but not limited to, strains, lacerations, and pinch points).	If handling drums, use drum dolly, pallet on forklift, or drum grabber attached to backhoe or excavator to more drums into storage. If handling drums, inspect path that drum must be moved over. Ensure that there are no ruts or other obstacles that can cause drum to tip over or be difficult to handle over surface being traversed. Place drums in approved storage area. When manually handling drums, avoid placing hands between drums and pinching fingers. Wear appropriate PPE. Avoid manually positioning drums if at all possible.
	Slip, trip, and fall hazards.	Maintain good housekeeping and proper illumination in storage area.

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(7) IDW REMOVAL AND DISPOSAL		
Prepared by: Sarah McCall Date: 03/21/08	**Reviewed by: Steve Rosansky Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
4. Store drums in temporary storage location pending characterization.	Drums may leak.	Inspect all containers on a regular basis (weekly for non-hazardous materials, daily for hazardous materials). Have spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work steel-toed footwear with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.
5. Remove cover of containers for sampling.	Lifting drum lids may cause injury, particularly to fingers and hands.	Identify and avoid pinch points, such as placing hands between drum lid and drum. Wear leather work gloves when removing and replacing drum lids.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force, extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching or pressing with hands and fingers.
	Containers could contain atmospheric hazards, thus exposing worker to vapors.	Before fully lifting container covers, place probe 1 to 2 inches above the opening and measure air inside using a PID meter. If reading is less than 10 ppm, open cover and proceed with sampling. If reading is greater than 10 ppm, remove cover slowly and stand back to allow cover to ventilate. Measure air (1 to 2 inches) inside again after 5 minutes, and if readings are still above 10 ppm, contact that SHSO.
6. Collect sample waste.	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.
7. Replace container covers.	Replacing drum lids may cause injury, particularly to fingers and hands.	Use care when replacing drum lids. Wear appropriate PPE.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools. Mark and tag "out of service". Select hand tools to minimize the following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
8. Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Try to pack shipping boxes so less than 60 lbs.

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ACTIVITY HAZARD ANALYSIS

(7) IDW REMOVAL AND DISPOSAL		
Prepared by: Sarah McCall Date: 03/21/08	**Reviewed by: Steve Rosansky Date: 11/24/08**	
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
8. Pack samples for shipment. (Continued)	Contents of sample containers could leak, causing exposure to worker and possibly people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure boxes meet required packaging standards based on mode of transportation used for shipping.
9. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy items. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could be exposed to chemical contaminants	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear steel-toed footwear with good traction.
10. Load containers for transport.	Handling of containers can expose worker to injury (including, but not limited to, strains, lacerations, and pinch points.)	Ensure drums are individually properly labeled (new labels as appropriate based on analytical results) and that labels are visible when drums are placed on truck. Use truck that has "Tommy Lift" and move drum using drum dolly onto lift. Ensure drum is secure and will not roll when lift is raised. Wheel drum to appropriate location on truck for transport. Be sure to evenly distribute load weight on bed of truck. Secure drums in place on the truck. If drums are loaded with drum handling device attached to heavy equipment, stand way from truck when drum is placed on truck. Once drum is placed and "loader" moves away from truck, use drum dolly on truck to position drum. Avoid placing pallets of drums on truck unless pallets can be positioned where they will remain for transport.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when loading drums close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
	Containers may leak.	Inspect all containers prior to transport. Have spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work steel-toed footwear with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.

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ACTIVITY HAZARD ANALYSIS

(7) IDW REMOVAL AND DISPOSAL		
Prepared by: Sarah McCall Date: 03/21/08		**Reviewed by: Steve Rosansky Date: 11/24/08**
Principal Steps	**Potential Safety/ Health Hazards**	**Recommended Controls**
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools PID	Pre/Post maintenance Visual prior to use	Tailgate Safety Meeting Site specific orientation Hazard observation and communication Air Monitoring

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(8) MONITORING WELL LOCATION SURVEY		
Prepared by: Sarah McCall **Date: 03/21/08**	**Reviewed by: Steve Rosansky** **Date: 11/24/08**	
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
1. Park contractor vehicle at site.	Vehicle could hit someone or something	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment from vehicle.	Lifting of instruments from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
3. Move equipment to designated survey location.	Handling of instruments could cause strain to worker.	Carry instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Openings 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools	Pre/Post maintenance Visual prior to use	Tailgate Safety Meeting Site specific orientation Hazard observation and communication

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(9) GROUNDWATER SAMPLING		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
1. Park vehicle at well.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment and materials from vehicle.	Lifting of equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person. Use mechanical lifting equipment (hand carts, trucks) to move large, heavy, or awkward loads.
3. Move equipment and materials to designated sampling well location.	Handling of equipment could cause strain to worker.	Use care when walking so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Slip, trip, and fall hazards could be present.	Maintain good housekeeping in work area. Mark or remove all identified trip, slip, and fall hazards from sampling area. Maintain proper illumination in work area.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when well is close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
4. Remove well vault cover and well cap.	Lifting of well vault cover could cause back strain.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help if cover is too heavy or it is too difficult to handle because cover is wedged or impaired. If cover is on hinges, ensure that cover is secured in uprights position by latching or tie-off to prevent cover from falling on worker while worker is in well vault.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Worker could get hand caught between cover and box when lifting cover.	Use caution when lifting well vault cover. Wear appropriate PPE when handling covers.
	Well covers and openings to ground and vault areas may have insects, such as black widow and brown recluse spiders.	Wear appropriate PPE when opening well cover. Inspect opening or vault for insects. If insects are present, avoid them or remove them while wearing adequate PPE. Have first aid kit available to treat insect stings. (If allergic to any insect bites, notify SHSO. If possible, a person not

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(9) GROUNDWATER SAMPLING		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
		allergic to insect bites should open covers).
4. Remove well vault cover and well cap. (Continued)	Well vaults could have atmospheric hazards if well has off-gassed and the vault space has not cleared, thus exposing worker to vapors.	If well has historically contained high vapor contaminant concentrations, before lifting cover to vault, place probe near the opening (1 to 2" away) in or around cover and measure air inside using PID. If reading is less than 10 ppm, open well cover and proceed with work activities. If reading is greater than 10 ppm, open well cover slowly, secure cover, and stand back to allow vault to ventilate. Measure air inside again (1 to 2") after 5 minutes, and if readings are still above 10 ppm, contact the SHSO.
5. Measure depth to groundwater.	Worker could be exposed to chemical contaminants.	Wear appropriate PPE.
6. Set up sampling equipment.	Polyethylene sheeting can be slippery if used.	Wear steel-toed footwear with traction. Use caution when maneuvering on or around polyethylene sheeting, especially if sheeting is wet.
	Worker could be exposed to pinch points.	Use care when setting up equipment. Wear appropriate PPE if necessary.
7. Purge well.	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE. Avoid spills. Ensure spill cleanup supplies are available.
8. Collect groundwater samples.	Collecting samples over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during sampling to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching or pressing.
	Worker could be exposed to chemical contaminants.	Review hazardous properties of site contaminants with workers before operations begin. Wear required PPE Visual inspection and ambient air monitoring will determine selection of PPE. Decontaminate exteriors of sample containers. Avoid spills. Ensure that spill cleanup supplies are available.
9. Replace well cap and well vault cover.	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select the appropriate hand tools for the task.
	Worker could get hand caught between vault cover and box when replacing cover.	Use care when replacing well vault cover. Wear appropriate PPE when handling covers.
10. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE. Remove

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(9) GROUNDWATER SAMPLING		
Prepared by: Sarah McCall Date: 03/21/08 Reviewed by: Steve Rosansky Date: 11/24/08		
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
		PPE properly and wash hands.
10. Decontaminate all reusable materials and equipment. (Continued)	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear steel-toed footwear with good traction.
11. Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 60 pounds. Lifts greater than 50 lbs, especially repeated lifts, need to be evaluated and approved by a qualified person.
	Contents of sample containers could leak, causing exposure to worker and possibly to people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure that boxes meet required packaging standards based on mode of transportation used for shipping.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools PID	Pre/Post maintenance Visual prior to use	Tailgate Safety Meeting Site specific orientation Hazardous waste operations Hazard observation and communication Air Monitoring

ATTACHMENT 3
ACTIVITY HAZARD ANALYSIS

(10) DEMOBILIZATION		
Prepared by: Sarah McCall **Date: 03/21/08**	**Reviewed by: Steve Rosansky**	**Date: 11/24/08**
Principal Steps	**Potential Safety/Health Hazards**	**Recommended Controls**
1. Demobilization/ Site Cleanup	Struck by Equipment	All equipment, augers, rods and tools will be properly secured during transport.
	Unstable Drill Rig	Never move the drilling rig with the mast upright. Set hydraulic leveling jacks before raising the mast.
	Backing Up Equipment	Use a ground guide along with a functioning back-up alarm during equipment backing.
	Electrocution	All extension cords shall be rated "hard usage" or "extra hard usage" per EM385-1-1. Use GFCIs. Patched, oil soaked, worn, or frayed electrical cords or cables shall not be used.
	Pinch Points	Avoid placing hands close to moving machinery. Wear appropriate PPE.
	Use of Power Tools	All recommended controls & actions that apply to power equipment also apply to hand tools. Inspect power cords for wear and damage. Do not use equipment with damaged cords. Use GFCI on extension cords when working outside or in wet environments. Wear appropriate PPE.
	Slips, Trips, Falls	Clear ground hazards. Practice good housekeeping to keep the ground around the site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.
Equipment To Be Used	**Inspection Requirements**	**Training Requirements**
PPE Hand tools	Pre/Post maintenance Visual prior to use	Tailgate safety meeting Site specific orientation Hazard observation and communication

ATTACHMENT 4

HEALTH AND SAFETY FORMS

SAFETY INSPECTION CHECKLIST FOR CONSTRUCTION EQUIPMENT

(Including Cranes, Derricks and Hoisting Equipment)

PROJECT	CONTRACTOR	CONTRACT NO.
TYPE AND MAKE OF EQUIPMENT	MODEL	SERIAL NO.

Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent mechanic and certified to be in good operating condition. Records of tests and inspections shall be maintained as part of the active contract file at Project or Resident Office. Checklist set forth herein requires the application of EM 385-1-1, Safety and Health Requirements Manual, 1 Oct 87. The appropriate EM paragraph to be applied is listed at the end of each testing requirement.

CHECKLIST	Yes	No	NA
1. Are adequate and serviceable fire extinguishers provided? (13.A.01)			
2. Are all wire rope cables in good condition? (17.C.01)			
3. Are wire rope, sockets, splices, thimbles, and clips adequate and properly applied? (17.C.09)			
4. Are hooks, safety nooks, shackles, rings, etc. in good condition? (17.A.02, 17.A.05)			
5. Are necessary platforms, footwalks, etc. provided? (18.8.08)			
6. Are access steps, platforms, etc. provided with non-slip surfaces? (18.8.08, 19.A.14, 26.8.03)			
7. Is operator protected against the elements, falling or flying objects, swinging loads, and similar hazards? (18.8.18, 19.A.13, 18.8.17, 18.8.19, 18.8.21)			
8. Are all glasses in operator's compartment safety glass and in good repair? (19.A.15, 19.A.16, 18.8.18)			
9. Is suitable access provided to lubrication points? (18.A.18)			
10. Do all modifications, extensions, replacement parts, and/or repairs to equipment maintain the same factor of safety as original designed equipment? (18.A.33, 18.C.04)			
11. Are drums for load lines equipped with at least one positive holding device, applied directly to the motor shaft or some part of the train gear? (18.C.05)			
12. Is there sufficient cable to allow two full wraps of cable on drums at all working positions? (18.C.07)			
13. Are adequate headlights, tail-lights and turn signals provided and are they in proper operating condition? (19.A.06, 18.A.15)			
14. Are all approved brakes on wheeled equipment and in good operating condition? (18.A.21, 18.A.22, 19.A.07, 19.A.08)			
15. Do windshields have wipers in proper operating condition? (18.A.10, 18.A.28)			
16. Are rear view mirrors provided? (19.A.12)			
17. Are operating levels equipped with latch or other devices to prevent accidental starting? (19.A.21)			
18. Is engine equipped with power-operated starting device in operative condition? (18.A.24)			

CHECKLIST	Yes	No	NA
19. Do all pressure vessels have valid inspection certificates? (21.A.01, 21.B.01, 21.C.01, 21.D.01)			
20. Are reverse signal alarms on equipment? (18.8.01)			
21. Are belts, gears, shafts, electrical contacts, etc. adequately guarded? (18.B.03, 16.A.04)			
22. Are all hot pipes and surfaces suitably guarded? (18.B.04)			
23. Are fuel tanks located so that spills or overflows will not come in contact with engine or exhaust? (18.B.05)			
24. Are exhausts and discharges so directed as not to endanger workmen or obstruct view of operator? (18.B.06)			
25. Are guards in place on equipment with drop type skip pans? (18.B.07)			
26. Are adequate seats provided for all riders? (18.A.07, 19.C.01, 18.C.02)			
27. Are tires in serviceable condition? Are testing/inspections documented? (18.A.01, (19.A.03)			
28. Are steering linkage and tire rod in good operating condition? Are testing/ inspections documented? (18.A.01)			
29. Are dump bodies provided with holding device or other suitable device for locking body in raised position? (18.A.20)			
30. Are tailgate dumping devices so arranged that operator will be in the clear while dumping loads? (18.A.22)			
31. Are trip-handles provided on tailgates to facilitate handling? (18.A.22)			
32. Is air hose free from leaks or defects? (18.A.07)			
33. Are safety lashings for quick make-up type connections provided? (16.E.03, 12.A.18)			
34. Is acceptable spark arrestor installed and working? (18.B.06, 12.C.03)			
35. Do heating devices comply with references? (08.8, 12.0)			
36. Does welding equipment comply with code requirements? (14.A.01, 14.A.02, 14.A.03, 15.A.04)			
37. Is equipment adequately grounded? (14.C.02, 14.C.03, 16.A.08)			
38. Do electrical components comply with code? (16.A.01)			
39. Are required pressure, temperature or relief gages and valves installed and operable? (21.A.10, 21.A.11, 08.B.06)			
40. Are approved seat belts and roll-over protection provided? (18.B.16, 18.B.20)			
41. Is recommended preventative maintenance being followed? (18.A.03)			
42. Do helicopter cranes meet construction requirements? (18.Q.01, 18.Q.04, 18.Q.10)			
43. Do hydraulic jacks meet special safety conditions? (18.R)			
44. Is concrete equipment fitted with adequate safety devices? (18.O.02, 18.O.03, 18.O.05, 18.O.07, 18.O.08)			
45. Are elevating and rotating work platforms in conformance with ANSI A92.2? (18.N.01)			
46. Do conveyors, cableways, and related equipment conform to ANSI B20.01? (18.K.01)			
47. Are pile drivers equipped with all appropriate safety devices? (18.I)			

CHECKLIST	Yes	No	NA
48. Do material hoists conform to ANSI A10.5? (18.I)			
49. Do passenger elevators conform to ANSI A10.4? Do temporary hoists conform in accordance to ANSI A10.22? (18.H.01)			
50. Do hand and power tools comply with applicable ANSI standards? (SEC 16)			
The following site questions apply to Cranes and Hoisting Equipment only and need not be answered for other construction equipment.			
51. Is high voltage sign posted? (15.E.06, 18.C.02)			
52. Is equipment fitted with positive stops for rotation when near power lines? (16.E.09)			
53. Is there any visible evidence of damage to boom? (18.A.01, 18.C.01)			
54. Is the boom position indicator operating and visible to operator? (18.D.04, 18.C.13, 18.E.08, 18.F.03, 18.G.04)			
55. Have all operators had a current physical examination? (05.A.01, 05.B.03)			
56. Is braking equipment capable of effectively braking, lowering and safety holding a load of at least the full rated load as required? (18.C.06)			

REMARKS:

CERTIFICATION: I hereby certify that this item of equipment is in good operating condition and that it meets all above requirements except as noted under remarks. SIGNATURE OF COMPETENT MECHANIC DATE SIGNATURE OF SUPERINTENDENT/QUALITY CONTROL ENGINEER DATE

AIR MONITORING DATA SHEET

DATE	TIME	LOCATION	INSTRUMENT READING	COMMENTS

Site Safety Officer:_____ Date:_____

TAILGATE SAFETY MEETING FORM

Date: Time: Job Number:

Client: Address:

Site Location:

Scope of Work:

Site Safety Officer: Construction Manager:

Safety Topics Presented

Protective Clothing/Equipment:

Chemical Hazards:

Physical Hazards:

Special Equipment:

Emergency Procedures:

Hospital: Phone: Ambulance Phone:

Hospital Address: Hospital Route:

Attendees

Name Printed:	Signature:

Meeting Conducted By: Signed By:

SAFETY COMPLIANCE AGREEMENT FORM

Site: _____

Contract No. _____

Project No. _____

SHSO: _____

I acknowledge that I have read the information in this Accident Prevention Plan and its associated Attachments. I understand the site hazards as described and agree to comply with the contents of the plan.

Signature & Printed Name	Company	Date

When an emergency situation arises, appropriate immediate emergency response actions must be taken to protect Staff Members and to contain the emergency. Immediate emergency response actions apply to the following scenarios:

- Loss of ventilation triggered by power outage or other emergencies
- Fire and /or explosion
- Personal injury and illness
- Spills not contained within the laboratory hood or within the immediate area.

	Laboratory Hood	Other LEV Devices
Loss of Ventilation	• Stop work • Place a cover or lid over chemical container if possible • Close the hood sash • Consider evacuation of the lab area • Alert Facility management and immediate manager/supervisor	• Stop work • Alert Facility management and immediate manager/supervisor
Fire/Explosion	• Stop work • Close the hood sash • See SBMS Fire Extinguishers Procedure Area • NOTE: If a Staff Member's clothing is on fire, it is critical that they STOP, DROP and ROLL to extinguish the fire. If the Staff Member is running with his/her clothes on fire, they should be knocked to the ground and rolled.	• Stop work • See SBMS Fire Extinguishers Procedure Area NOTE: If a Staff Member's clothing is on fire, it is critical that they STOP, DROP and ROLL to extinguish the fire. If the Staff Member is running with his/her clothes on fire, they should be knocked to the ground and rolled.
Personal Injury/Illness	• See SBMS procedure area on Injury, Accident, and Incident Reporting and Investigations	• See SBMS procedure area on Injury, Accident, and Incident Reporting and Investigations
Spills of hazardous materials that cannot be contained	• Stop work • Close the hood sash • Inform management • Refer to SBMS on Spill Response • Refer to SBMS on Radiological Spill Response if spill involves radioactive material.	• Stop work • Inform management • Refer to SBMS on Spill Response • Refer to SBMS on Radiological Spill Response if spill involves radioactive material.

	Laboratory Hood	Other LEV Devices
Minor or manageable spills that can be cleaned up by staff	• Stop work • Assess risks of spills to personal safety and determine whether it is safe to proceed with clean up • Ensure appropriate PPE is available and used • Clean up spill • Inform management and other emergency contacts as required	• Stop work • Assess risks of spills to personal safety and determine whether it is safe to proceed with clean up • Ensure appropriate PPE is available and used • Clean up spill • Inform management and other emergency contacts as required

Instructions for Completing the Incident Analysis Form

Instructions appear in red text. If you have additional questions about completing the Incident Analysis Form contact your S&H Representative.

The **shaded section** will be completed by a member of the Safety, Health & Emergency Response Department or Environmental Protection Department.

NOTE: This section to be filled in by Safety Health &Emergency Response and/or Environmental Protection		
Event Report Number: from e.r. system	IA Report Number: from SH&ER share point file	OSHA Case Log Number: from Health Services
OSHA Recordable: ___ Yes ___ No	Type of recordable: ___ LWD ___ RD ___ Other;	OSHA Reportable: ___ Yes ___ No
EPA Reportable Incident: __ Yes __ No	Mercury spill __ Yes __ No	Oil spill __ Yes __ No

SECTION I instructions – This section will be filled out for **ALL** incidents reported.
(1) Indicate the date the incident occurred. Enter the date as day/month/year.
(2) Indicate the time of the incident using a 12-hour clock. Approximate if an exact time is not known.
(3) Indicate the date an involved staff member or witness reports the incident. Use the same format as date of incident.
(4) Indicate Yes if the incident resulted in injury to a Battelle staff member or a person directly supervised by a Battelle staff member. If Yes than all sections of the form must be completed. If there was no injury then check No and continue with section III (omit Section II).

SECTION I	Date of Incident (dd/mm/yyyy): (1) __/__/____	Time of Incident: (2) ___AM ____PM	Date Reported: (3)
Did Incident result in Injury to Battelle Staff or a Battelle supervised person (4) __Yes __No (**If yes fill out ALL sections. If no omit Section II.**)			

Section II Instructions – This must be filled out when an incident involves injury to a Battelle staff member or a person who is directly supervised by a Battelle staff member.
(1) Fill in the name of the injured person.
(2) Provide the Battelle employee identification number. If it is not a Battelle staff member indicate the company the employee works for in the Employee Identification box.
(3) Indicate the Battelle location the staff member reports to. Note this is not the location where the incident occurred.
(4) Include the division.
(5) Organization code of the staff member. This will be 'N/A' for non-Battelle employees.
(6) Indicate the treatment that took place immediately following the incident.
(7) Indicate the type of injury if known.
(8) Indicate the body part injured.

SECTION II	Staff Member's Name: (1)		Employee Identification Number: (2)
Reporting Location: (3)	Division: (4)		Organization Code: (5)
Treatment at Time of Incident: (6) ___ First Aid ___ EMT ___ Battelle Health Services ___ Other Medical Provider ___ No treatment at time of incident			
Injury Type (cut, bruise, strain, etc) (7)		Location of Injury (hand, foot, etc) (8)	

Section III Instructions – This section will be filled out for **ALL** incidents reported.
(1) Indicate the type of incident. Note – Check all that apply.
(2) List the name(s) of the staff members directly involved. This is the person(s) who was injured and/or directly performing the task when the incident occurred.
(3) Describe the job or task being performed at the time of the incident.
(4) Indicate the length of the employee has been time in the job assignment for the job being performed at the time of the incident.
(5) List the name(s) of any witnesses to the incident.
(6) Describe the incident. This will be completed from data collected as a part of the analysis of the incident. Data includes information from employee interviews, data on the task being performed and other physical data collected at the time of the incident. There is no specified format for additional pages if more room is needed to describe the incident.

SECTION III	(1) Type of Incident: ___ Near-miss ___ Chemical Spill ___ Environmental Release ___ Property Damage ___ Injury/Illness ___Other
Name(s) of staff members involved: (2)	
Job Assignment at Time of Incident: (3)	Was this a routine part of the job? (3) ___Yes ___ No
Time in Job Assignment: (4) ___ 0-14 days ___ 15-90 days ___ 3 months to 1 year ___ 1 to 3 years ___ 4-10 years ___ more than 10 years	
Name(s) of witnesses: (5)	
Describe What Happened: Describe in sufficient detail to allow the scene to be visualized by a reader. Include what the staff member(s) was doing (task performed and experience in performing the task), where the incident occurred, what tools, equipment, chemicals etc were being used, what the result was. A complete description of the facts will aid in determining the cause(s) and corrective actions. Attach additional pages if necessary. (6)	

Instructions for Completing the Incident Analysis Form

Section IV Instructions – This section will be filled out for **ALL** incidents reported. Once the analysis is complete indicate what the probable causes are. As a reminder – categories of causes include Task, Material, Environmental, Personal/Human, and Management/Process factors. Also identify the proposed/planned corrective action(s). These should be directly linked to the causes. If there are any reference documents to clarify or provide details to the cause(s) or corrective actions(s), such as drawings or technical specifications, indicate what they are where they can be found if they cannot be attached.

SECTION IV	
Causes(s)	**Proposed/Planned Corrective Action(s)**
Reference Documents (if any):	

Section V Instructions – This section will be filled out for **ALL** incidents reported. Once the initial analysis is completed the Manager should indicate his/her comments and actions. Names and signatures should be obtained in the order that they appear left to right and top to bottom. Note the manager final review is not completed until the S&H Representative or Environmental Protection Staff Member indicates the incident analysis is complete.

SECTION V		
Manager's Comments/Actions:		
Staff Member Name and Date	Supervisor's Name and Date	Witness Name and Date
Other Investigator's Name and Date	Other Investigator's Name and Date	Witness Name and Date
SH&ER/Environmental Protection Comments/Actions:		
Manager (final review) Name and Date:	SH&ER/Environmental Protection Name and Date	

SBMS Form: Worker Safety and Health Management System	**Issue Date: 7/17/07**

Incident Analysis

NOTE: This section to be filled in by Safety Health &Emergency Response and/or Environmental Protection		
Event Report Number:	IA Report Number:	OSHA Case Log Number:
OSHA Recordable: ☐Yes ☐ No	Type of recordable: ☐LWD ☐RD ☐Other;	OSHA Reportable: ☐Yes ☐No
EPA Reportable Incident: ☐Yes ☐No	Mercury spill ☐Yes ☐No	Oil spill ☐Yes ☐No

SECTION I	Date of Incident (dd/mm/yyyy):	Time of Incident: AM PM	Date Reported:
Did Incident result in Injury to Battelle Staff or a Battelle supervised person ☐Yes ☐No (**If yes fill out ALL sections. If no omit Section II.**)			

SECTION II	Staff Member's Name:	Employee Identification Number:
Reporting Location:	Division:	Organization Code:
Treatment at Time of Incident: ☐First Aid ☐EMT ☐Battelle Health Services ☐Other Medical Provider ☐No treatment at time of incident		
Injury Type (cut, bruise, strain, etc)	Location of Injury (hand, foot, etc)	

SECTION III	Type of Incident: ☐Near-miss ☐Chemical Spill ☐Environmental Release ☐Property Damage ☐Injury/Illness ☐Other
Name(s) of staff members involved:	
Job Assignment at Time of Incident:	Was this a routine part of the job? ☐Yes ☐No
Time in Job Assignment: ☐0-14 days ☐15-90 days ☐3 months to 1 year ☐1 to 3 years ☐4-10 years ☐more than 10 years	
Name(s) of witnesses:	
Describe What Happened: Describe in sufficient detail to allow the scene to be visualized by a reader. Include what the staff member(s) was doing (task performed and experience in performing the task), where the incident occurred, what tools, equipment, chemicals etc were being used, what the result was. A complete description of the facts will aid in determining the cause(s) and corrective actions. Attach additional pages if necessary.	

SECTION IV	
Causes(s)	**Proposed/Planned Corrective Action(s)**
Reference Documents (if any):	

SECTION V		
Manager's Comments/Actions:		
Staff Member Name and Date	Supervisor's Name and Date	Witness Name and Date
Other Investigator's Name and Date	Other Investigator's Name and Date	Witness Name and Date
SH&ER/Environmental Protection Comments/Actions:		
Manager (final review) Name and Date:	SH&ER/Environmental Protection Name and Date	

Form Number:	Revision Number:	Effective Date
ESHQ-SIH-FM-004 1		06/14/2007

ATTACHMENT 5

CONTRACTOR SIGNIFICANT INCIDENT REPORT

☐ Initial Report

☐ Follow-up Report

☐ Final Report

Contractor Significant Incident Report (CSIR)

1. General Information

Contracting Activity/ROICC Office:

Accident Classification:

☐ Injury ☐ Fatality ☐ Environment ☐ Procedural Issues ☐ Lessons Learned

☐ Illness ☐ Property Damage ☐ Other_____

Involving:

☐ Confined Space ☐ Equip/Mrt Ver/Mat Handling (Heavy Construction Equip.) ☐ Hazardous Material

☐ Crane and Rigging ☐ Equip/Mrt Ver/Mat Handling (Material Handling) ☐ Trenching/Excavation

☐ Diving ☐ Equip/Mrt Ver/Mat Handling (Man-Lift/Elevated Platform) ☐ Waterfront/Marine

☐ Demolition/Renovation ☐ Fall from Ladder ☐ Fall from Scaffold ☐ Other_____

☐ Electrical ☐ Fall from Roof ☐ Fire

2. Personal Information

Name (Last, First, MI):	**Age:**	**Sex:**

Job Title/Description:	**Employed By:**
Supervisor Name (Last, First, MI) & Title:	**Was the person trained to perform this activity/task?** ☐ **Yes** ☐ **No**
What type of training was received (OJT, classroom, etc)?	**Date of the most recent formal training and topics discussed?**

3. Witness Information

Witness #1: Name (Last, First, MI):	**Job Title/Description:**
Employed By:	**Supervisor Name (Last, First, MI):**
Witness #2: Name (Last, First, MI):	**Job Title/Description:**
Employed By:	**Supervisor Name (Last, First, MI):**

Additional Witnesses: ☐ **Yes** ☐ **No**

(List any additional witnesses on a separate sheet and attach.)

4. Contract Information

Type of Contract:

☐ A/E ☐ BOS ☐ CLEAN ☐ Construction ☐ Design Build ☐ FSCC ☐ FSSC

☐ JOC ☐ RAC ☐ Service ☐ Other_____

Contract Number & Title:	**Industrial Group & Industrial Type:**
Prime Contractor Name/Address/Phone & Fax No: **Safety Manager (Last, First, MI):** **Insurance Carrier:**	**Sub Contractor Name/Address/Phone & FAX No:** **Safety Manager (Last, First, MI):** **Insurance Carrier:**

5. Accident Description

Date of Accident:	**Time of Accident:**	**Exact Location of Accident:**

Describe the accident in detail in your words: ***(Use the back of page if you need additional space)***

Direct Cause(s) of Accident:

Indirect Cause(s) of Accident:

Action(s) taken to prevent re-occurrence or provide on-going corrective actions:

Corrective Action Beginning Date:	**Anticipated Completion Date:**

Personal Protective Equipment:

☐ Available and used ☐ Available and not used ☐ Not Required

☐ Not related to Mishap ☐ Wrong PPE for job

List PPE Used:

Type of Construction Equipment (Make, Model, Serial #, VIN#) Involved:

Was Hazardous Material Spilled/Released? ☐ **Yes** ☐ **No**

Please List Hazardous Material(s) Involved:

Who provided first aid or cleanup of mishap site?

Any blood-borne pathogen exposure, other than EMTs? ☐ **Yes** ☐ **No**

Who?

List OSHA and EM-385-1-1 standards that were violated:

Was site secured and witness statements taken immediately? ☐ **Yes** ☐ **No**

By Whom?

6. Injury Illness/Fatality Information

Severity of Injury/Illness:

- ☐ Fatality
- ☐ Lost Workday Case Involving Days Away From Work
- ☐ Temporary Disabillity
- ☐ Recordable Workday Case Involving Restricted Duty
- ☐ Permanent Total Disability
- ☐ Other Recordable Case
- ☐ Recordable First Aid Case
- ☐ Permanent Partial Disability
- ☐ Non-Recordable Case
- ☐ No Injury

Estimated Days Lost:	**Estimated Days Hospitalized:**	**Estimated Days Restricted Duty:**

List Primary Body Part Affected:	**List Other Body Part(s) Affected:**

Nature of Injury/Illness for Primary Body Part (Examples: Amputation, Burn, Hernia):

Type of Accident (Examples: Fall same level, Lifting, Bitten, Exerted):

Source of Accident (Examples: Crane, Carbon Monoxide, Ladder, Welding Equipment):

7. Causal Factors *(Explain answers on supplementary sheet)*

• **Design – Design of facility, workplace, or equipment was a factor?**	☐ **Yes** ☐ **No**
• **Inspection/Maintenance – Inspection & Maintenance procedures were a factor?**	☐ **Yes** ☐ **No**
• **Persons Physical Condition – In your opinion, the physical condition of the person was a factor?**	☐ **Yes** ☐ **No**
• **Operation Procedures – Operating procedures were a factor?**	☐ **Yes** ☐ **No**
• **Job Practices – One or more job safety/health practices not being followed when the accident occurred contributed to the accident?**	☐ **Yes** ☐ **No**
• **Human Factors – One or more human factors, such as a person's size or strength contributed to the accident?**	☐ **Yes** ☐ **No**
• **Environmental Factors – Heat, cold, dust, sun, glare, etc., contributed to the accident?**	☐ **Yes** ☐ **No**
• **Chemical and Physical Agent Factors – Exposure to chemical agents, such as dust, fumes, mist, vapors, or physical agents such as noise, radiation, etc., contributed to the accident?**	☐ **Yes** ☐ **No**
• **Office Factors – Office setting such as lifting office furniture, carrying, stooping, contributed to the accident?**	☐ **Yes** ☐ **No**
• **Support Factors – Inappropriate tools/resources were provided to perform the task?**	☐ **Yes** ☐ **No**
• **PPE – Improper selection, use or maintenance of PPE contributed to the accident?**	☐ **Yes** ☐ **No**
• **Drugs/Alcohol – In your opinion, were drugs or alcohol a factor?**	☐ **Yes** ☐ **No**
• **Job Hazard Analysis – The lack of an adequate (IAW-EM-385-1-1 Sec 01.A) activity hazard analysis was a contributing factor.**	☐ **Yes** ☐ **No**
• **Job Hazard Analysis – JHA was not site specific and/or did not address the type of work/operations performed when the mishap occurred.**	☐ **Yes** ☐ **No**
• **Management – A lack of adequate supervision contributed to the accident.**	☐ **Yes** ☐ **No**
• **Management – Inadequate information was provided at pre con meeting.**	☐ **Yes** ☐ **No**

8. OSHA Information			
Date OSHA was Notified:	**Date(s) of Investigation:**	**Date of citation:** ***(Attach Copy)***	**Dollar amount of Penalties:**

9. Report Preparer	
Name (Last, First, MI):	**Date of Report:**
Title: **Employer:** **Phone #:**	**Signature:**

CONTRACTOR SIGNIFICANT INCIDENT REPORT (CSIR) INSTRUCTIONS
Complete Sections Appropriate to Incident (Rev. 06/02).

NOTE: THE ATTACHED CSIR FORM IS TO BE USED BY CONTRACTORS TO RECORD THE RESULTS OF THEIR ACCIDENT/INCIDENTS INVESTIGATIONS AND SHALL BE PROVIDED TO THE CONTRACTING OFFICER WITHIN THE REQUIRED TIMEFRAMES.

GENERAL. Complete a separate report for each person who was injured in the accident. A report needs to be completed for all OSHA recordable accidents, property damage in excess of $2000.00 (This amount is for record purposes only. GOV is not required to enter property damage reports into FAIR database if it is less than $10,000.00.), WHE accidents, or near miss/high visibility mishaps. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es), non-applicable sections shall be marked "N/A". If additional space is needed, provide the information on a separate sheet of paper and attach to the completed form.

Mark the report:
INITIAL – If this form is being used as initial notification of a Fatality or High Visibility Mishap. The initial form is due within 4 hours of a serious accident. A form marked 'Follow-up' or 'Final' is required within 5 days.
FOLLOW-UP – If you are providing additional information on a report previously submitted.
FINAL – If you are providing a completed report and expect no changes.

SECTION 1 – GENERAL INFORMATION

CONTRACTING ACTIVITY/ROICC OFFICE - Enter the name and address of the Contracting Office administering the contract under which the mishap took place (e.g. ROICC MCBH, ROICC NORFOLK, PWC GUAM, etc.).

ACCIDENT CLASSIFICATION - INJURY/ILLNESS/FATALITY/PROPERTY DAMAGE/-PROCEDURAL ISSUES/-ENVIRONMENTAL/LESSONS LEARNED/OTHER – Mark the appropriate block(s) if the incident resulted in any of these conditions.

INVOLVING - If the mishap involved any of the conditions listed under "Involving" mark the appropriate box(es). Specific questions associated with each of these conditions are available from the Contracting Officer to assist you in your investigation. When these questions are used they shall be attached as part of this report.

SECTION 2 - PERSONAL INFORMATION

NAME - Enter last name, first name, middle initial of person involved.
AGE - Enter age.
SEX - Enter M for Male and F for Female.
JOB TITLE/DESCRIPTION - Enter the job title/description assigned to the injured person (e.g. carpenter, laborer, surveyor, etc.).
EMPLOYED BY - Enter employment company name of the person involved.
SUPERVISOR'S NAME & TITLE - Enter name and title of the immediate supervisor.
WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK? - For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.
TYPE OF TRAINING - Indicate the specific type of training (classroom or on-the-job) that the injured person received before the accident happened.
DATE OF MOST RECENT FORMAL TRAINING/TOPICS DISCUSSED - Enter the month, day, and year of the last *formal* training completed that covered the activity/task being performed at the time of the accident. List topics that were discussed at the training identified above.

SECTION 3 - WITNESS INFORMATION

The following applies to Witness #1 and Witness #2:
WITNESS NAME - Enter last name, first name, middle initial of the witness.
JOB DESCRIPTION/TITLE - Enter the job title/description assigned to the witness (e.g. carpenter, laborer, surveyor, etc.).
EMPLOYED BY - Enter the name of the employment company of the witness.
SUPERVISORS NAME - Enter name of immediate supervisor of the witness.
ADDITIONAL WITNESSES - Provide same information, as above, for each witnesses. Use additional pages if necessary.

SECTION 4 - CONTRACTOR INFORMATION

TYPE OF CONTRACT - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.
CONTRACT NUMBER/TITLE - Enter complete contract number and tile of prime contract (e.g. N62477-85-C-0100, 184 Pearl City Hsg. Revitalization).
CONSTRUCTION INDUSTRIAL GROUP AND INDUSTRIAL TYPE – This is the type of construction that will be done at this project.

1. First, you must choose the Industrial Group. You have 4 choices to choose from: (**NOTE!** Review of the Industrial Types below and knowing what the projects scope of work is will assist you in deciding what the Industrial Group should be.)

a. Buildings
b. Heavy Industrial
c. Infrastructure
d. Light Industrial

2. Once you have chosen the Industrial Group, you now select the Industrial Type. You have multiple choices under each Group, chose the one you feel fits the project most closely because on most projects there won't be an exact match:

a. Buildings:
   (1) Communications Ctr.
   (2) Dormitory/Hotel
   (3) High-rise Office
   (4) Hospital
   (5) Housing
   (6) Laboratory
   (7) Low-rise Office
   (8) Maintenance Facility
   (9) Parking Garage
   (10) Physical Fitness Ctr.
   (11) Restaurant/Nightclub
   (12) School
   (13) Warehouse
b. Heavy Industrial:
   (1) Chemical Mfg.
   (2) Electrical (Generating)
   (3) Environmental
   (4) Metals Refining/Processing
   (5) Mining
   (6) Natural Gas Processing
   (7) Oil Exploration/Production
   (8) Oil Refining
   (9) Pulp and Paper
c. Infrastructure:
   (1) Airport
   (2) Electrical Distribution
   (3) Flood Control
   (4) Highway
   (5) Marine Facilities
   (6) Navigation
   (7) Rail
   (8) Tunneling
   (9) Water/Wastewater
d. Light Industrial:
   (1) Automotive Assembly/Mfg.
   (2) Consumer Products Mfg.
   (3) Foods
   (4) Microelectronics Mfg.
   (5) Office Products Mfg.
   (6) Pharmaceuticals Mfg.

CONTRACTOR'S NAME/ADDRESS/PHONE NUMBER

(1) PRIME - Enter the exact name (title of firm), address, phone and fax numbers of the prime contractor.
(2) SUBCONTRACTOR - Enter the exact name, address, phone and fax numbers of any subcontractor involved in the accident.

SAFETY MANAGER'S NAME

(1) PRIME - Enter the name of the prime contractor safety manager.
(2) SUBCONTRACTOR - Enter the name of the subcontractors safety manager.

INSURANCE CARRIER

(1) PRIME - Enter the exact name/title of the prime's insurance company. Policy number not required.
(2) SUBCONTRACTOR - Enter the exact name of the subcontractor's insurance company. Policy number not required.

SECTION 5 - ACCIDENT DESCRIPTION

DATE OF ACCIDENT - Enter the month, day, and year of accident.
TIME OF ACCIDENT - Enter the local time of accident in military time. Example: 14:30 hrs (not 2:30 p.m.).
EXACT LOCATION OF ACCIDENT - Enter facts needed to locate the accident scene (installation/project name, building/room number, street, direction and distance from closest landmark, etc.).
DESCRIBE THE ACCIDENT IN DETAIL. Fully describe the accident in the space provided. If property damage involved, give estimated dollar amount of damage and/or repair costs involved. If additional space is needed continue on a separate sheet and attach to this report. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Ensure questions below regarding direct cause(s), indirect cause(s), and actions taken are answered. **NOTE!** Review questions in Section 7 below before completing.
DIRECT CAUSE(S) - The direct cause is that single factor which most directly lead to the accident. See examples below.
INDIRECT CAUSE(S) - Indirect cause are those factors, which contributed to, but did not directly initiate the occurrence of the accident.

Examples for Direct and Indirect Cause:
1. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: Failure to provide fall protection at elevation

Indirect causes: Failure to enforce safety requirements: improper training/motivation of employee (possibility that employee was not knowledgeable of fall protection requirements or was lax in his attitude toward safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

2. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by contractor vehicle. (note contractor vehicles was in proper safe working condition.)
Direct cause: Failure of contractor driver to maintain control of and stop contractor vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

ACTION(S) TAKEN TO PREVENT RE-OCCURRENCE OR PROVIDE ON-GOING CORRECTIVE ACTIONS. Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on back or additional sheets of paper if necessary to fully explain and attach to the complete report form.
CORRECTIVE ACTION DATES -
(1) Beginning - Enter the date when the corrective action(s) identified above will begin.
(2) Anticipated Completion - Enter the date when the corrective action(s) identified above will be completed.
PERSONAL PROTECTIVE EQUIPMENT (PPE) - Mark appropriate box(es) and list PPE which was being used by the injured person at the time of the accident (e.g. protective clothing, shoes, glasses, goggles, respirator, safety belt, harness, etc.)
TYPE OF CONTRACTOR EQUIPMENT - Enter the Serial Number, Model Number and specific type of equipment involved in the mishap (e.g. dump truck (off highway), crane (rubber tire), pump truck (concrete), etc.).
WAS HAZARDOUS MATERIAL SPILLED/RELEASED? - Mark appropriate block and list name(s) of any reportable quantities of hazardous materials spilled/released during the mishap.
WHO PROVIDED FIRST AID OR CLEAN-UP OF MISHAP SITE? - List name(s) of individual(s) and employer, if known.
ANY BLOOD-BORNE PATHOGEN EXPOSURE, OTHER THAN EMT? - Mark appropriate block and list name(s) of individual(s) and employer, if known.
LIST OSHA AND/OR EM 385-1-1 STANDARDS THAT WERE VIOLATED. - Self explanatory.
WAS SITE SECURED AND WITNESS STATEMENT TAKEN IMMEDIATELY? - Mark appropriate block and list by whom.

SECTION 6 - INJURY/ILLNESS/FATALITY INFORMATION

SERVERITY OF INJURY/ILLNESS – Mark appropriate box.
ESTIMATED DAYS LOST - Enter the estimated number of workdays the person will lose from work. Update when final data is known.
ESTIMATED DAYS HOSPITALIZED - Enter the estimated number of workdays the person will be hospitalized. Update when final data is known.
ESTIMATED DAYS RESTRICTED DUTY - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties. Update when final data is known.
BODY PART(S) AFFECTED - Enter the most appropriate primary and when applicable, secondary, etc. body part(s) affected (e.g. arm: wrist: abdomen: single eye; jaw : both elbows: second finger: great toe: collar bone: kidney, etc.).
NATURE OF INJURY/ILLNESS FOR PRIMARY BODY PART - Enter the most appropriate nature of injury/illness (e.g. amputation, back strain, dislocation, laceration, strain, asbestosis, food poisoning, heart conditions, etc.).
TYPE AND SOURCE OF INJURY/ILLNESS - Type and Source Codes are used to describe what caused the incident.
(1) TYPE Code stands for an "Action" (Example: Worker, installing conduit, lost his balance and fell five feet from a ladder. Type Code: Fell different levels".) Select the most appropriate Type of injury from the list below:

TYPE OF INJURY/ILLNESS

STRUCK BY/AGAINST	CONTACTED CONTACTED WITH (INJURED PERSON MOVING) CONTACTED BY (OBJECT WAS MOVING)
FELL, SLIPPED, TRIPPED SAME LEVEL/DIFFERENT LEVEL/NO FALL	EXERTED LIFTED, STRAINED BY (SINGLE ACTION) STRESSED BY (REPEATED ACTION)
CAUGHT ON/IN/BETWEEN	EXPOSED INHALED/INGESTED/ABSORBED/EXPOSED TO
PUNCTURED, LACERATED PUNCTURED BY/CUT BY/STUNG BY/BITTEN BY	TRAVELING IN

(2) SOURCE Code stands for an "object or substance." (Example: Worker, installing conduit, lost his balance and fell five feet from a ladder. Source Code: "Ladder".) Select the most appropriate Source of injury from the list below:

SOURCE OF INJURY/ILLNESS

BUILDING OR WORKING AREA WALKING/WORKING AREA STAIRS/STEPS LADDER FURNITURE BOILER/PRESSURE VESSEL EQUIPMENT LAYOUT WINDOWS/DOORS ELECTRICITY	DUST, VAPOR, ETC. DUST (SILICA, COAT, ETC.) FIBERS ASBESTOS GASES CARBON MONOXIDE MIST, STEAM, VAPOR, FUME WELDING FUMES PARTICLES (UNIDENTIFIED)

ENVIRONMENT CONDITION TEMPERATURE EXTREME (INDOOR) WEATHER (ICE, RAIN, HEAT, ETC.) **FIRE, FLAME, SMOTE (NOT TABACCO)** NOISE RADIATION LIGHT VENTILATION TOBACCO SMOKE STRESS (EMOTIONAL) CONFINED SPACE	CHEMICAL, PLASTIC, ETC. DRY CHEMICAL - CORROSIVE DRY CHEMICAL - TOXIC DRY CHEMICAL - EXPLOSIVE DRY CHEMICAL - FLAMMABLE LIQUID CHEMICAL - CORROSIVE LIQUID CHEMICAL - TOXIC LIQUID CHEMICAL - EXPLOSIVE LIQUID CHEMICAL - FLAMMABLE PLASTIC WATER MEDICINE
MACHINE OR TOOL HAND TOOL (POWERED: SAW, GRINDER, ETC.) HAND TOOL (NON POWERED) MECHANCIAL POWER TRANSMISSION APPARATUS GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK) VIDEO DISPLAY TERMINAL PUMP, COMPRESSOR, AIR PRESSURE TOOL HEATING EQUIPMENT WELDING EQUIPMENT	INANIMATE OBJECT BOX, BARREL, ETC. PAPER METAL ITEM, MINERAL NEEDLE GLASS SCRAP, TRASH, WOOD FOOD CLOTHING, APPAREL, SHOES
MACHINE OR TOOL HAND TOOL (POWERED: SAW, GRINDER, ETC.) HAND TOOL (NON POWERED) MECHANCIAL POWER TRANSMISSION APPARATUS GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK) VIDEO DISPLAY TERMINAL PUMP, COMPRESSOR, AIR PRESSURE TOOL HEATING EQUIPMENT WELDING EQUIPMENT	INANIMATE OBJECT BOX, BARREL, ETC. PAPER METAL ITEM, MINERAL NEEDLE GLASS SCRAP, TRASH, WOOD FOOD CLOTHING, APPAREL, SHOES
VEHICLE AS DRIVER OF PRIVATELY OWNED, RENTAL VEH. AS PASSENGER OF PRIVATELY OWNED, RENTAL VEH. DRIVER OF GOVERNMENT VEHICLE PASSENGER OF GOVERNMENT VEHICLE COMMON CARRIER (AIRLINE, BUS, ETC.) AIRCRAFT (NOT COMMERCIAL) BOAT, SHIP, BARGE	ANIMATE OBJECT DOG OTHER ANIMAL PLANT INSECT HUMAN (VIOLENCE) HUMAN (COMMUNICABLE DISEASE) BACTERIA, VIRUS (NOT HUMAN CONTACT)
MATERIAL HANDLING EQUIPMENT EARTHMOVER (TRACTOR, BACKHOE, ETC.) CONVEYOR (FOR MATERIAL AND EQUIPMENT) ELEVATOR, ESCALATOR, PERSONNEL HOIST HOIST, SLING CHAIN, JACK CRANE FORKLIFT HANDTRUCK , DOLLY	PERSONAL PROTECTIVE EQUIPMENT PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES RESPIRATOR, MASK DIVING EQUIPMENT SAFETY BELT, HARNESS PARACHUTE

SECTION 7 - CAUSAL FACTORS

Review thoroughly. Answer each question by marking the appropriate block. **NOTE!** If any answer is yes, explain in section 5 above.

(1) **DESIGN** - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?
(2) **INSPECTION/MAINTENANCE** - Did inadequately or improperly maintained equipment, tools, workplace, etc., create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?
(3) **PERSONS PHYSICAL CONDITION** - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was overexertion a factor?
(4) **OPERATION PROCEDURES** - Did lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?
(5) **JOB PRACTICES** - Were any of the provision of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?
(6) **HUMAN FACTORS** - Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person: i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach strengths, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?
(7) **ENVIRONMENTAL FACTORS** - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun temperature changes, wind, tides, floods, currents, terrain; dust, mud, glare, pressure changes, lighting, etc., play a part in the accident?

(8) **CHEMICAL AND PHYSICAL AGENT FACTORS** - Did exposure to chemical agents (either single shift exposure or long-term exposure such as dusts, fibers, (asbestos, etc.), silica, gases (carbon, monoxide, chlorine, etc.), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?
(9) **OFFICE FACTORS** - Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?
(10) **SUPPORT FACTORS** - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized and adequate to provide proper tools, equipment, personnel, site preparation, etc.
(11) **PERSONAL PROTECTIVE EQUIPMENT** - Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?
(12) **DRUGS/ALCOHOL** - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".
(13) **JOB/ACTIVITY HAZARD ANALYSIS** - Was a written Job/Activity Analysis completed for the task being performed at the time of the accident? If one was made, did it address the hazard adequately or does it need to be updated? If none made, will one be made? These may also need to be addressed in the Corrective Actions Taken section. Mark the appropriate box. If one was made, attach a copy of the analysis to the report.
(14) **MANAGEMENT** - Did the lack of supervisor or management support play a part in the mishap? Mark the appropriate box.

SECTION - 8 OSHA INFORMATION - Complete this section if applicable

SECTION 9 - REPORT PREPARER

Providing a completed CSIR to the Contracting Officer is the PRIME CONTRACTOR'S RESPONSIBILITY. Enter the name, date of report, title, employer, phone number and signature of person completing the accident report and provide it to the Contracting Officer, or his representative, responsible for oversight of that contractor activity. **NOTE!** If prepared by other than the Prime Contractor, a person employed by the Prime Contractor must sign that they have reviewed and concur with the report and it's findings (e.g. company owner, project supervisor/foreman, Safety Officer, etc.).

ATTACHMENT 6

MATERIAL SAFETY DATA SHEETS

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

SYMYX TECHNOLOGIES, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: CIS-1,2-DICHLOROETHYLENE

TRADE NAMES/SYNONYMS:
CIS-ACETYLENE DICHLORIDE; 1,2-DICHLOROETHYLENE; C2H2CL2; OHS05125; RTECS KV9420000

CHEMICAL FAMILY: halogenated, aliphatic

CREATION DATE: Mar 12 1986
REVISION DATE: Sep 13 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: CIS-1,2-DICHLOROETHYLENE
CAS NUMBER: 156-59-2
EC NUMBER (EINECS): 205-859-7
EC INDEX NUMBER: 602-026-00-3
PERCENTAGE: 100.0

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=2

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: alcohol odor
MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, central nervous system depression
PHYSICAL HAZARDS: May explode. Flammable liquid and vapor. Vapor may cause flash fire. May polymerize. Containers may rupture or explode. May decompose on contact with air, light, moisture, heat or storage and use above room temperature. Releases toxic, corrosive, flammable or explosive gases.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, nausea, vomiting, drowsiness, symptoms of drunkenness
LONG TERM EXPOSURE: no information on significant adverse effects
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: same as effects reported in short term exposure

EYE CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: same as effects reported in short term exposure
INGESTION:
SHORT TERM EXPOSURE: symptoms of drunkenness
LONG TERM EXPOSURE: no information on significant adverse effects

CARCINOGEN STATUS:
OSHA: No
NTP: No
IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For ingestion, consider gastric lavage. Consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Moderate explosion hazard. Vapor/air mixtures are explosive above flash point. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Water may be ineffective.

FLASH POINT: 39 F (4 C) (CC)
LOWER FLAMMABLE LIMIT: 9.7%
UPPER FLAMMABLE LIMIT: 12.8%
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
CIS-1,2-DICHLOROETHYLENE:
1,2-DICHLOROETHYLENE (ALL ISOMERS):
200 ppm (790 mg/m3) OSHA TWA
200 ppm ACGIH TWA
200 ppm (790 mg/m3) NIOSH recommended TWA 10 hour(s)
800 mg/m3 (200 ml/m3) DFG MAK (peak limitation category - II, with excursion factor of 2)
200 ppm (806 mg/m3) UK WEL TWA
250 ppm (1010 mg/m3) UK WEL STEL

MEASUREMENT METHOD: NIOSH IV # 1003; OSHA 7

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
2000 ppm
Any supplied-air respirator operated in a continuous-flow mode.
Any powered, air-purifying respirator with organic vapor cartridge(s).
Any air-purifying respirator with a full facepiece and an organic vapor canister.
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Emergency or planned entry into unknown concentrations or IDLH conditions -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor

canister.
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
COLOR: colorless
ODOR: alcohol odor
MOLECULAR WEIGHT: 96.94
MOLECULAR FORMULA: C2-H2-CL2
BOILING POINT: 140 F (60 C)
FREEZING POINT: -114 F (-81 C)
VAPOR PRESSURE: 400 mmHg @ 41 C
VAPOR DENSITY (air=1): 3.34
SPECIFIC GRAVITY (water=1): 1.2837
WATER SOLUBILITY: insoluble
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not available
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: acetone, benzene, ether, alcohol

10. STABILITY AND REACTIVITY

REACTIVITY: May decompose on contact with air, light, moisture, heat or storage and use above room temperature. Releases toxic, corrosive, flammable or explosive gases.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: bases, metals, combustible materials, oxidizing materials, acids

1,2-DICHLOROETHYLENE (ALL ISOMERS):
CAUSTIC ALKALIES (SOLID OR CONCENTRATED SOLUTIONS): May form explosive, spontaneously flammable chloroacetylene.
COPPER OR COPPER ALLOYS: May form explosive, spontaneously flammable chloroacetylene.
DIFLUOROMETHYLENE DIHYPOFLUORITE (WITH TRANS-ISOMER): Violent explosion at room temperature.
FREE RADICAL INITIATORS: Oxidation forms corrosive chloroacetyl chloride via epoxide intermediates.
METAL (HOT): Gradual decomposition with release of corrosive hydrogen chloride.
NITROGEN TETROXIDE: Explosive, especially when shocked.
OXIDIZERS (STRONG): Fire and explosion hazard.
OZONE: Form explosive product.

PERCHLORYL FLUORIDE: Explosive reaction on heating.
POTASSIUM HYDROXIDE (SOLID OR CONCENTRATED SOLUTION): May form explosive, spontaneously flammable chloroacetylene.
PLASTICS, RUBBER AND COATINGS: May be attacked.
SODIUM: May form explosive, spontaneously flammable chloroacetylene.
SODIUM HYDROXIDE (SOLID OR CONCENTRATED SOLUTION): May form explosive, spontaneously flammable chloroacetylene.
SULFURIC ACID (CONCENTRATED): Oxidation forms corrosive chloroacetyl chloride via epoxide intermediates.
STRONG OXIDIZERS: Vigorous reaction or possible fire and explosion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: phosgene, halogenated compounds, oxides of carbon

POLYMERIZATION: May polymerize. Avoid contact with incompatible materials.

11. TOXICOLOGICAL INFORMATION

CIS-1,2-DICHLOROETHYLENE:
TOXICITY DATA: 13700 ppm inhalation-rat LC50; 65 gm/m3/2 hour(s) inhalation-mouse LCLo; 20 gm/m3/6 hour (s) inhalation-cat LCLo
LOCAL EFFECTS:
Irritant: inhalation, skin, eye
ACUTE TOXICITY LEVEL:
Slightly Toxic: inhalation
TARGET ORGANS: central nervous system
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: respiratory disorders
MUTAGENIC DATA: mutation in microorganisms - Saccharomyes cerevisae 100 mmol/L (-S9); gene conversion and miotic recombination - Saccharomyes cerevisae 40 mmol/L; unscheduled DNA synthesis - rat liver 4300 umol/L; host-mediated assay - mouse Saccharomyes cerevisae 1300 mg/kg
ADDITIONAL DATA: Stimulants such as epinephrine and ephedrine may enhance the toxicity of some halogenated hydrocarbons.

HEALTH EFFECTS:
INHALATION:
ACUTE EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Vapor exposure may cause mucous membrane irritation, nausea, vomiting, dizziness, weakness, tremor, and epigastric cramps. Higher levels may cause central nervous system depression ranging from drowsiness to unconsciousness. The cis- and trans- isomers together have been used as an anesthetic in man. A human death has been reported from industrial exposure. An 8 hour exposure to the trans- isomer at 200 ppm lowered the leukocyte count in rats; 1000 ppm caused a fall in the blood serum albumin, urea nitrogen, alkaline phosphatase activity, and the number of erythrocytes. Narcosis was not produced at these levels. 3000 ppm produced fibrous swelling of the cardiac muscle and hyperemia which persisted for 14 hours after exposure. The cis- isomer did not anesthetize rats in 4 hours at 8000 ppm, but at 16,000 ppm they were anesthetized in 8 minutes and killed in 4 hours. Reversible superficial corneal turbidity has been observed in some anesthetized dogs.

CHRONIC EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Variations in data exist on the chronic toxicity of the cis- and trans- isomers. Rats exposed to 200 ppm of the trans- isomer for 8 hours/day, 5 days/week for 16 weeks showed histological evidence of slight to severe fatty degeneration of liver lobules and kupffer cells, marked pulmonary hyperemia, alveolar septal distension and fibrous swelling of the cardiac muscle. Similar exposures with rats, guinea pigs, rabbits and dogs exposed to 500 ppm or 1000 ppm 7 hours/day, 5 days/week for 6 months to a mixture of 60% cis- and 40% trans- isomers resulted in no adverse effects detected. Cats and rabbits were repeatedly exposed to vapor concentrations of 0.16-0.19% in air. The cis- isomer caused anorexia, decreased body weight and pathological changes in the lungs, liver, and kidneys. The trans- isomer caused anorexia and some respiratory irritation, but no histopathological changes in

organs.

SKIN CONTACT:
ACUTE EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Direct contact may cause irritation. Skin absorption may occur due to lipid solubility.

CHRONIC EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Repeated or prolonged contact may cause dermatitis.

EYE CONTACT:
ACUTE EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Direct contact, or the vapor in sufficient concentration, may cause irritation. The trans- isomer caused burning of the eyes at 2000 ppm. Reversible superficial corneal turbidity has been reported as a systemic effect in dogs following inhalation exposure.

CHRONIC EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Repeated or prolonged contact with irritants may cause conjunctivitis.

INGESTION:
ACUTE EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Depending on exposure, symptoms may vary from slight central nervous system depression to deep narcosis.

CHRONIC EXPOSURE:
1,2-DICHLOROETHYLENE (ALL ISOMERS): Used as a low temperature extracting agent for heat sensitive substances such as caffeine in coffee, perfumes, and oils and fats from fish and meat. Mice exposed to 22 mg/kg or 220 mg/kg of trans-1,2 dichloroethylene by gavage for 14 consecutive days showed a trend toward suppression of the humoral immune response, but no effect on the cell-mediated immune response.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
ID NUMBER: UN1150
HAZARD CLASS OR DIVISION: 3
PACKING GROUP: II
LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS: 3
PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS: 3
CLASSIFICATION CODE: F1
PACKING GROUP: II
LABELS: 3

LAND TRANSPORT RID:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS: 3
CLASSIFICATION CODE: F1
PACKING GROUP: II
LABELS: 3

AIR TRANSPORT IATA:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
UN/ID NUMBER: UN1150
CLASS OR DIVISION: 3
HAZARD LABELS: 3
PACKING GROUP: II

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS OR DIVISION: 3
LABELS: 3
UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: 1,2-Dichloroethylene
UN NUMBER: UN1150
CLASS OR DIVISION: 3
PACKING GROUP: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: No
FIRE: Yes
REACTIVE: Yes
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
1,2-DICHLOROETHYLENE (ALL ISOMERS)

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
Xn	Harmful

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:

EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 20	Harmful by inhalation.
R 52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S 2	Keep out of the reach of children.
S 7	Keep container tightly closed.
S 16	Keep away from sources of ignition - No smoking.
S 29	Do not empty into drains.
S 61	Avoid release to the environment. Refer to special instructions/Safety data sheets.

CONCENTRATION LIMITS:
C>=25% Xn R 20-52/53
12.5%<=C<25% Xn R 20

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 2

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

SYMYX TECHNOLOGIES, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: ISOBUTENE

TRADE NAMES/SYNONYMS:
2-METHYLPROPENE; ISOBUTYLENE; LIQUIFIED PETROLEUM GAS; 2-METHYL-1-PROPENE; L.P.G.; GAMMA-BUTYLENE; ASYM-DIMETHYL ETHYLENE; UN 1055; OHS11610; RTECS UD0890000

CHEMICAL FAMILY: hydrocarbons, aliphatic

CREATION DATE: Feb 03 1986
REVISION DATE: Sep 13 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: ISOBUTENE
CAS NUMBER: 115-11-7
EC NUMBER (EINECS): 204-066-3
EC INDEX NUMBER: 601-012-00-4
PERCENTAGE: 100

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=4 REACTIVITY=0

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: gas, volatile liquid
ODOR: petroleum odor
MAJOR HEALTH HAZARDS: central nervous system depression, difficulty breathing
PHYSICAL HAZARDS: Flammable gas. May cause flash fire. Flash back hazard.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, nausea, vomiting, headache, symptoms of drunkenness, disorientation, tingling sensation, suffocation, convulsions, coma
LONG TERM EXPOSURE: no information on significant adverse effects
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation (possibly severe)
LONG TERM EXPOSURE: no information is available
EYE CONTACT:

SHORT TERM EXPOSURE: irritation, blurred vision
LONG TERM EXPOSURE: no information on significant adverse effects
INGESTION:
SHORT TERM EXPOSURE: frostbite
LONG TERM EXPOSURE: no information is available

CARCINOGEN STATUS:
OSHA: No
NTP: No
IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115 F; 41-46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If a large amount is swallowed, get medical attention.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking. Stop flow of gas.

FLASH POINT: -105 F (-76 C)
AUTOIGNITION: 869 F (465 C)

6. ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
ISOBUTENE:
No occupational exposure limits established.

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.

GLOVES: Wear insulated gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: gas
COLOR: colorless
PHYSICAL FORM: gas, volatile liquid
ODOR: petroleum odor
MOLECULAR WEIGHT: 56.12
MOLECULAR FORMULA: C4-H8
BOILING POINT: 19 F (-7 C)
FREEZING POINT: -220 F (-140 C)
VAPOR PRESSURE: 1.96 mmHg @ 20 C
VAPOR DENSITY (air=1): 1.9
SPECIFIC GRAVITY (water=1): 0.5879 @ 25 C
WATER SOLUBILITY: almost insoluble

PH: Not applicable
VOLATILITY: Not applicable
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not applicable
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable
SOLVENT SOLUBILITY:
Soluble: organic solvents, alcohol, ether, sulfuric acid

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: oxidizing materials

ISOBUTENE:
OXIDIZING MATERIAL: May react.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

ISOBUTENE:
TOXICITY DATA: 314000 mg/m3/2 hour(s) inhalation-mouse LC50; 250000 mg/m3/2 hour(s) inhalation-mouse LC16; 680000 mg/m3/2 hour(s) inhalation-mouse LC84; 550000 mg/m3/4 hour(s) inhalation-rat LC50; 514000 mg/m3/4 hour(s) inhalation-rat LC16; 720000 mg/m3/4 hour(s) inhalation-rat LC84
ACUTE TOXICITY LEVEL:
Relatively Non-toxic: inhalation
TARGET ORGANS: central nervous system
TUMORIGENIC DATA: 252000 mg/kg inhalation-rat TCLo/105 week(s) intermittent

HEALTH EFFECTS:
INHALATION:
ISOBUTENE: May cause irritation of the mucous membranes. Isobutene is a mild anesthetic and may cause at large concentrations symptoms of dizziness, dullness, shortness of breath, disorientation, excitation, headaches, and vomiting. Severe exposure may cause loss of consciousness, convulsions, coma, and possible death. See information on simple asphyxiants.

ACUTE EXPOSURE:
SIMPLE ASPHYXIANTS: The symptoms of asphyxia depend on the rapidity with which the oxygen deficiency develops and how long it continues. In sudden acute asphyxia, unconsciousness may be immediate. With slow development there may be rapid respiration and pulse, air hunger, dizziness, reduced awareness, tightness in the head, tingling sensations, incoordination, faulty judgement, emotional instability, and rapid fatigue. As the asphyxia progresses, nausea, vomiting, collapse, unconsciousness, convulsions, deep coma and death are possible.

CHRONIC EXPOSURE:
SIMPLE ASPHYXIANTS: No data available.

SKIN CONTACT:

ACUTE EXPOSURE:
ISOBUTENE: Contact with liquified gas may cause frostbite, redness, pain and burns.

CHRONIC EXPOSURE:
ISOBUTENE: No data available.

EYE CONTACT:
ACUTE EXPOSURE:
ISOBUTENE: Contact with the vapor may cause irritation of the eyes. Eye contact with liquified gas may cause frostbite, redness, pain and blurred vision.

CHRONIC EXPOSURE:
ISOBUTENE: No effects reported in humans.

INGESTION:
ACUTE EXPOSURE:
ISOBUTENE: Ingestion of a gas is unlikely. If liquid is swallowed, frostbite damage of the lips, mouth and mucous membranes may occur.

CHRONIC EXPOSURE:
ISOBUTENE: No data available.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Isobutylene
ID NUMBER: UN1055
HAZARD CLASS OR DIVISION: 2.1
LABELING REQUIREMENTS: 2.1
QUANTITY LIMITATIONS:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: 150 kg

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Isobutylene
UN NUMBER: UN1055
CLASS: 2.1

LAND TRANSPORT ADR:
PROPER SHIPPING NAME: Isobutylene
UN NUMBER: UN1055
CLASS: 2
CLASSIFICATION CODE: 2F
LABELS: 2.1

LAND TRANSPORT RID:
PROPER SHIPPING NAME: Isobutylene
UN NUMBER: UN1055
CLASS: 2
CLASSIFICATION CODE: 2F
LABELS: 2.1; (+13)

AIR TRANSPORT IATA:
PROPER SHIPPING NAME: Isobutylene
UN/ID NUMBER: UN1055
CLASS OR DIVISION: 2.1
HAZARD LABELS: 2.1

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: Isobutylene
UN NUMBER: UN1055
CLASS OR DIVISION: 2.1
LABELS: 2.1

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Isobutylene
UN NUMBER: UN1055
CLASS OR DIVISION: 2.1

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: No
FIRE: Yes
REACTIVE: No
SUDDEN RELEASE: Yes

SARA TITLE III SECTION 313 (40 CFR 372.65): Not regulated.

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):

F+	Extremely Flammable

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:

F+

EC RISK AND SAFETY PHRASES:

R 12	Extremely flammable.
S 2	Keep out of the reach of children.
S 9	Keep container in a well-ventilated place.
S 16	Keep away from sources of ignition - No smoking.
S 33	Take precautionary measures against static discharges.

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 0

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

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MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423

1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: LIQUI-NOX(R)

TRADE NAMES/SYNONYMS:
LIQUI-NOX; 00201730

PRODUCT USE: water-based cleaner

CREATION DATE: Aug 31 1998
REVISION DATE: Mar 19 2003

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: NON-HAZARDOUS SUBSTANCE
CAS NUMBER: Not assigned.
EC NUMBER: Not assigned.
PERCENTAGE: >1

COMPONENT: WATER
CAS NUMBER: 7732-18-5
EC NUMBER (EINECS): 231-791-2
PERCENTAGE: >1

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=1 REACTIVITY=0

EMERGENCY OVERVIEW:
COLOR: yellow
PHYSICAL FORM: liquid
ODOR: faint odor

MAJOR HEALTH HAZARDS: No significant target effects reported.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: no information on significant adverse effects
LONG TERM EXPOSURE: no information on significant adverse effects
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: same as effects reported in short term exposure
EYE CONTACT:
SHORT TERM EXPOSURE: no information on significant adverse effects
LONG TERM EXPOSURE: no information on significant adverse effects
INGESTION:
SHORT TERM EXPOSURE: digestive disorders, diarrhea
LONG TERM EXPOSURE: no information on significant adverse effects

CARCINOGEN STATUS:
OSHA: No
NTP: No
IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If a large amount is swallowed, get medical attention.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Slight fire hazard.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical, regular foam, water

FIRE FIGHTING: Move container from fire area if it can be done without risk. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

FLASH POINT: none, COC

6. ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. See original container for storage recommendations. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
LIQUI-NOX(R):
No occupational exposure limits established.

VENTILATION: Based on available information, additional ventilation is not required.

CLOTHING: Protective clothing is not required under normal conditions.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: No respirator is required under normal conditions of use. Under conditions of frequent use or heavy exposure, respiratory protection may be needed.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
COLOR: yellow
ODOR: faint odor
BOILING POINT: 214 F (101 C)
FREEZING POINT: Not available
VAPOR PRESSURE: Not available
VAPOR DENSITY: Not available
SPECIFIC GRAVITY (water=1): 1.075
WATER SOLUBILITY: soluble
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: Not available
EVAPORATION RATE: slower than butyl acetate
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Avoid contact with incompatible materials.

INCOMPATIBILITIES: oxidizing materials

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: oxides of sulfur

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

HEALTH EFFECTS:
INHALATION:
ACUTE EXPOSURE:
LIQUI-NOX: No data available.

CHRONIC EXPOSURE:
LIQUI-NOX: No data available.

SKIN CONTACT:
ACUTE EXPOSURE:
LIQUI-NOX: May cause local irritation causing drying and/or chapping.

CHRONIC EXPOSURE:
LIQUI-NOX: Prolonged contact may cause drying and or chapping.

EYE CONTACT:
ACUTE EXPOSURE:
LIQUI-NOX: No data available.

CHRONIC EXPOSURE:
LIQUI-NOX: No data available.

INGESTION:
ACUTE EXPOSURE:
LIQUI-NOX: May cause discomfort and/or diarrhea.

CHRONIC EXPOSURE:
LIQUI-NOX: No data available.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION: No classification assigned.

CANADIAN TRANSPORTATION OF DANGEROUS GOODS: No classification assigned.

LAND TRANSPORT ADR: No classification assigned.

LAND TRANSPORT RID: No classification assigned.

AIR TRANSPORT IATA: No classification assigned.

AIR TRANSPORT ICAO: No classification assigned.

MARITIME TRANSPORT IMDG: No classification assigned.

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: No
CHRONIC: No
FIRE: No
REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65): Not regulated.

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (CALCULATED): Not determined.

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423

1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: METHYL ALCOHOL

TRADE NAMES/SYNONYMS:
METHANOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; STANDARD WATER IN METHANOL; RCRA U154; UN 1230; CH4O; OHS14280; RTECS PC1400000

CHEMICAL FAMILY: alcohols

CREATION DATE: Sep 25 1984
REVISION DATE: Dec 09 2004

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: METHYL ALCOHOL
CAS NUMBER: 67-56-1
EC NUMBER (EINECS): 200-659-6
EC INDEX NUMBER: 603-001-00-X
PERCENTAGE: 100

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: alcohol odor
MAJOR HEALTH HAZARDS: skin irritation, eye irritation, central nervous system depression, nerve

damage
PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, cough, ringing in the ears, constipation, headache, drowsiness, dizziness, tingling sensation, pain in extremities, tremors, loss of coordination, blood disorders, nerve damage
LONG TERM EXPOSURE: irritation, sensitivity to light, changes in blood pressure, nausea, vomiting, diarrhea, stomach pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, pain in extremities, loss of coordination, visual disturbances, dilated pupils or pin-point pupils, blindness, bluish skin color, lung congestion, heart damage, kidney damage, liver damage, nerve damage, reproductive effects, effects on the brain, convulsions, unconsciousness, coma
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation, absorption may occur, headache, drowsiness, dizziness, loss of coordination, blood disorders
LONG TERM EXPOSURE: headache, drowsiness, dizziness, loss of coordination, blood disorders, nerve damage
EYE CONTACT:
SHORT TERM EXPOSURE: irritation, eye damage
LONG TERM EXPOSURE: irritation
INGESTION:
SHORT TERM EXPOSURE: irritation, sensitivity to light, changes in blood pressure, nausea, vomiting, diarrhea, stomach pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, pain in extremities, loss of coordination, visual disturbances, dilated pupils or pin-point pupils, blindness, bluish skin color, lung congestion, heart damage, kidney damage, liver damage, nerve damage, effects on the brain, convulsions, unconsciousness, coma
LONG TERM EXPOSURE: changes in blood pressure, headache, drowsiness, dizziness, loss of coordination, visual disturbances, blindness, bluish skin color, blood disorders, heart damage, kidney damage, liver damage, nerve damage, reproductive effects

CARCINOGEN STATUS:
OSHA: No
NTP: No
IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If a large amount is swallowed, get medical attention.

ANTIDOTE: ethanol, oral; calcium gluconate/glucose, intravenous. 4-methylpyrazole, oral,

intravenous.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

EXTINGUISHING MEDIA: alcohol resistant foam, carbon dioxide, regular dry chemical, water

Large fires: Use alcohol-resistant foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Dike for later disposal. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

FLASH POINT: 52 F (11 C) (CC)
LOWER FLAMMABLE LIMIT: 6.0%
UPPER FLAMMABLE LIMIT: 36.0%
AUTOIGNITION: 725 F (385 C)
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:
Reduce vapors with water spray.

SOIL RELEASE:
Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal.

WATER RELEASE:
Cover with absorbent sheets, spill-control pads or pillows. Remove trapped material with suction hoses.

Allow spilled material to aerate.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
METHYL ALCOHOL:
METHYL ALCOHOL (METHANOL):
200 ppm (260 mg/m3) OSHA TWA
250 ppm (328 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
200 ppm ACGIH TWA (skin)
250 ppm ACGIH STEL (skin)
200 ppm (260 mg/m3) NIOSH recommended TWA 10 hour(s) (skin)
250 ppm (325 mg/m3) NIOSH recommended STEL (skin)
270 mg/m3 (200 ml/m3) DFG MAK (peak limitation category - II, with excursion factor of 4) (cutaneous absorption danger)
260 mg/m3 (200 ml/m3) EC OEL
200 ppm (266 mg/m3) UK OES TWA (skin) (ILV)
250 ppm (333 mg/m3) UK OES STEL (skin) (ILV)

MEASUREMENT METHOD: Silica gel tube; Water; Gas chromatography with flame ionization detection; NIOSH IV # 2000, Methanol

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.
2000 ppm
Any supplied-air respirator.
5000 ppm
Any supplied-air respirator operated in a continuous-flow mode.
6000 ppm
Any supplied-air respirator with a tight-fitting facepiece that is operated in a continuous-flow mode.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Escape -
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-

pressure mode in combination with a separate escape supply.
Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
APPEARANCE: clear
COLOR: colorless
ODOR: alcohol odor
MOLECULAR WEIGHT: 32.04
MOLECULAR FORMULA: C-H3-O-H
BOILING POINT: 149 F (65 C)
FREEZING POINT: -137 F (-94 C)
VAPOR PRESSURE: 97.25 mmHg @ 20 C
VAPOR DENSITY (air=1): 1.11
SPECIFIC GRAVITY (water=1): 0.7914
WATER SOLUBILITY: soluble
PH: Not available
VOLATILITY: 100 % by volume
ODOR THRESHOLD: 100 ppm
EVAPORATION RATE: 4.6 (butyl acetate=1)
VISCOSITY: 0.59 cP @ 20 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: ether, benzene, alcohol, acetone, chloroform, ethanol, ketones, organic solvents

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Avoid inhalation of material or combustion by-products. Keep out of water supplies and sewers.

INCOMPATIBILITIES: halo carbons, combustible materials, metals, oxidizing materials, halogens, metal carbide, bases, acids, amines

METHYL ALCOHOL:
ACETYL BROMIDE: Violent reaction with formation of hydrogen bromide.
ALKYLALUMINUM SOLUTIONS: Violent reaction.
ALUMINUM: Corrodes.
BARIUM PERCHLORATE: Distillation yields highly explosive alkyl perchlorate.
BERYLLIUM HYDRIDE: Violent reaction, even at -196 C.
BROMINE: Vigorously exothermic reaction.
CALCIUM CARBIDE: Violent reaction.
CHLORINE: Possible ignition and explosion hazard.
CHLOROFORM AND SODIUM HYDROXIDE: Explosive reaction.
CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE): Possible ignition.
CYANURIC CHLORIDE: Violent reaction.

DICHLOROMETHANE: Possible ignition and explosion.
DIETHYL ZINC: Possible ignition and explosion.
HYDROGEN PEROXIDE + WATER: Explosion hazard.
IODINE + ETHANOL + MERCURIC OXIDE: Explosion hazard.
LEAD: Corrodes.
LEAD PERCHLORATE: Explosion hazard.
MAGNESIUM: Violent reaction.
MAGNESIUM (POWDERED): Mixtures are capable of detonation.
METALS: Incompatible.
NICKEL: Possible ignition in the presence of nickel catalyst.
NITRIC ACID (CONCENTRATED): Mixtures of greater than 25% acid may decompose violently.
OXIDIZERS (STRONG): Fire and explosion hazard.
PERCHLORIC ACID: Explosion hazard.
PHOSPHOROUS TRIOXIDE: Possible violent reaction and ignition.
PLASTICS, RUBBER, COATINGS: May be attacked.
POTASSIUM: Possible dangerous reaction.
POTASSIUM HYDROXIDE + CHLOROFORM: Exothermic reaction.
POTASSIUM TERT-BUTOXIDE: Fire and explosion hazard.
SODIUM + CHLOROFORM: Possible explosion.
SODIUM HYPOCHLORITE: Explosion hazard.
SODIUM METHOXIDE + CHLOROFORM: Violent reaction.
SULFURIC ACID: Fire and explosion hazard.
ZINC: Explosion hazard.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: oxides of carbon, various organic fragments

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

METHYL ALCOHOL:
IRRITATION DATA:
20 mg/24 hour(s) skin-rabbit moderate; 40 mg eyes-rabbit moderate; 100 mg/24 hour(s) eyes-rabbit moderate
TOXICITY DATA:
3571 ul/kg oral-man TDLo; 9450 ul/kg oral-man TDLo; 6422 mg/kg oral-man LDLo; 3429 mg/kg oral-man TDLo; 428 mg/kg oral-human LDLo; 143 mg/kg oral-human LDLo; 4 gm/kg oral-woman TDLo; 86000 mg/m3 inhalation-human TCLo; 300 ppm inhalation-human TCLo; 868 mg/kg unreported-man LDLo; 64000 ppm/4 hour(s) inhalation-rat LC50; 7529 mg/kg intraperitoneal-rat LD50; 2131 mg/kg intravenous-rat LD50; 7300 mg/kg oral-mouse LD50; 50 gm/m3/2 hour(s) inhalation-mouse LCLo; 10765 mg/kg intraperitoneal-mouse LD50; 4710 mg/kg intravenous-mouse LD50; 7500 mg/kg oral-dog LDLo; 7 gm/kg oral-monkey LD50; 1000 ppm inhalation-monkey LCLo; 393 mg/kg skin-monkey LDLo; 44 gm/m3/6 hour(s) inhalation-cat LCLo; 4641 mg/kg intravenous-cat LDLo; 14200 mg/kg oral-rabbit LD50; 15800 mg/kg skin-rabbit LD50; 1826 mg/kg intraperitoneal-rabbit LD50; 8907 mg/kg intravenous-rabbit LD50; 3556 mg/kg intraperitoneal-guinea pig LD50; 8555 mg/kg intraperitoneal-hamster LD50; 59 gm/kg parenteral-frog LDLo; 8 gm/kg oral-rat TDLo; 5000 ppm/6 hour(s) inhalation-rat TCLo; 9800 mg/kg subcutaneous-mouse LD50; 420 mg/kg oral-mouse LDLo; 120000 mg/m3/2 hour

(s) inhalation-mouse TCLo; 40000 mg/m3/4 hour(s) inhalation-mouse TCLo; 5600 mg/kg oral-rat LD50; 3490 mg/kg intraperitoneal-rat TDLo; 7500 mg/kg oral-rabbit LDLo; 81000 mg/m3/14 hour(s) inhalation-rabbit LC50; 4400 mg/m3/6 hour(s) inhalation-cat LCLo; 5000 mg/kg oral-monkey LDLo; 1300 mg/m3 inhalation-monkey LCLo; 3500 mg/kg oral-rat TDLo; 10 ml/kg oral-woman LDLo; 3 gm/kg oral-rat TDLo; 2885 mg/kg/3 day(s) intermittent oral-rat TDLo; 12 gm/kg/8 week(s) intermittent oral-rat TDLo; 7 ml/kg/7 day(s) intermittent oral-rat TDLo; 50 mg/m3/12 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 2610 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 3846 ug/kg/30 day(s) intermittent intraperitoneal-rat TDLo; 268.8 gm/kg/21 day(s) intermittent oral-rat TDLo; 2 ml/kg/4 day(s) intermittent skin-monkey TDLo; 6.5 mg/m3/6 hour(s)-4 week(s) intermittent inhalation-monkey TCLo; 6.5 mg/m3/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 50 mg/m3/12 hour(s)-120 day(s) intermittent inhalation-rat TCLo; 625 mg/kg/200 day(s) continuous oral-rat TDLo; 63000 mg/kg/3 week(s) intermittent oral-monkey TDLo; 10 mg/m3/4 hour(s)-213 day(s) intermittent inhalation-rat TCLo; 10 gm/kg/3 day(s) intermittent intraperitoneal-rat TDLo

LOCAL EFFECTS:

Irritant: skin, eye

ACUTE TOXICITY LEVEL:

Slightly Toxic: dermal absorption, ingestion

Relatively Non-toxic: inhalation

TARGET ORGANS: nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: eye disorders, kidney disorders, skin disorders and allergies

MUTAGENIC DATA:

DNA repair - Escherichia coli 20 mg/well; mutation in microorganisms - Saccharomyes cerevisae 12 pph (-S9); sex chromosone loss and non disjunction - Aspergillus nidulans 56000 ppm; cytogenetic analysis - grasshopper parenteral 3000 ppm; DNA inhibition - human lymphocyte 300 mmol/L; DNA damage - rat oral 10 umol/kg; mutation in microorganisms - mouse lymphocyte 7900 mg/L (+S9); cytogenetic analysis - mouse oral 1 gm/kg; cytogenetic analysis - mouse intraperitoneal 75 mg/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s)

REPRODUCTIVE EFFECTS DATA:

35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 20 gm/kg oral-rat TDLo 6-15 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 1-22 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 10000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 200 ppm oral-rat TDLo/20 hour(s) 78 week(s) male; 5200 ul/kg oral-rat TDLo 10 day(s) pregnant female continuous; 40 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 4 gm/kg oral-mouse TDLo 7 day(s) pregnant female continuous; 1500 ppm inhalation-mouse TCLo/6 hour(s) 7-9 day(s) pregnant female continuous; 5000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 7500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 2000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 15000 ppm inhalation-mouse TCLo 7-9 day(s) pregnant female continuous; 5 gm/kg intraperitoneal-mouse TDLo 5 day(s) male; 15000 ppm inhalation-rat TCLo/7 hour (s) 7-19 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 15-17 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 17-19 day(s) pregnant female continuous; 2.6 mg/m3 inhalation-rat TCLo 1-22 day(s) pregnant female continuous; 42 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous; 82 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous

ADDITIONAL DATA: May cause blindness.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

METHYL ALCOHOL: May cause irritation of the mucous membranes, coughing, oppression in the

chest, tracheitis, bronchitis, tinnitus, unsteady gait, twitching, colic, constipation, nystagmus, and blepharospasm. Symptoms from occupational exposure include paresthesias, numbness and shooting pains in the hands and forearms. Metabolic acidosis, and effects on the eyes and central nervous system may occur as detailed in acute ingestion.

CHRONIC EXPOSURE:
METHYL ALCOHOL: Repeated or prolonged exposure may cause effects as in acute ingestion. Repeated exposure to 200-375 ppm caused recurrent headaches in workers. Exposure for 4 years to 1200-8000 ppm resulted in marked diminution of vision and enlargement of the liver in a workman. Reproductive effects have been reported in animals.

SKIN CONTACT:
ACUTE EXPOSURE:
METHYL ALCOHOL: Contact with liquid may cause irritation. Skin absorption may occur and cause metabolic acidosis and effects on the eyes and central nervous system as detailed in acute ingestion.

CHRONIC EXPOSURE:
METHYL ALCOHOL: Repeated or prolonged contact with the liquid may cause defatting of the skin resulting in erythema, scaling, and eczematoid dermatitis. Chronic absorption may result in metabolic acidosis and effects as detailed in acute ingestion.

EYE CONTACT:
ACUTE EXPOSURE:
METHYL ALCOHOL: Vapors may cause irritation. High concentrations have been reported to cause violent inflammation of the conjunctiva and epithelial defects on the cornea. Mild irritation may occur with dilute solutions; the undiluted liquid has produced moderate corneal opacity and conjunctival redness in rabbits. Application of a drop of methanol in rabbit eyes caused a mild reversible reaction, graded 3 on a scale of 1-10 after 24 hours.

CHRONIC EXPOSURE:
METHYL ALCOHOL: Repeated or prolonged contact may cause conjunctivitis.

INGESTION:
ACUTE EXPOSURE:
METHYL ALCOHOL: May cause mild and transient inebriation and subsequent drowsiness followed by an asymptomatic period lasting 8-48 hours. Following the delay, coughing, dyspnea, headache, dullness, weakness, vertigo or dizziness, nausea, vomiting, occasional diarrhea, anorexia, violent pain in the back, abdomen, and extremities, restlessness, apathy or delirium, and rarely, excitement and mania may occur. Rapid, shallow respiration due to metabolic acidosis, cold and clammy skin, hypotension, cyanosis, opisthotonos, convulsions, mild tachycardia, cardiac depression, peripheral neuritis, cerebral and pulmonary edema, unconsciousness, and coma are possible. Effects on the eye may include optic neuritis, blurred or dimmed vision, dilated, unresponsive pupils, ptosis, eye pain, concentric constriction of visual fields, diplopia, change in color perception, photophobia, and optic nerve atrophy. Partial blindness or possibly delayed transient or permanent blindness may occur. Bilateral sensorineural deafness has been reported in a single case. Liver, kidney, heart, stomach, intestinal and pancreatic damage may also occur. Death may be due to respiratory failure or rarely from circulatory collapse. As little as 15 ml has caused blindness; the usual fatal dose is 60-240 ml. Prolonged asthenia and irreversible effects on the nervous system including difficulty in speech, motor dysfunction with rigidity, spasticity, and hypokinesis have been reported.

CHRONIC EXPOSURE:

METHYL ALCOHOL: Repeated ingestion may cause visual impairment and blindness and other systemic effects as detailed in acute ingestion. Reproductive effects have been reported in animals.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:
FISH TOXICITY: 74.3 ug/L 96 hour(s) LC50 (Mortality) Gudgeon (Gobio gobio)

INVERTEBRATE TOXICITY: 383 ug/L 48 hour(s) EC50 (Immobilization) Water flea (Daphnia magna)

ALGAL TOXICITY: 200-480 ug/L 8 hour(s) (Population) Algae,phytoplankton,algal mat (Algae)

PHYTOTOXICITY: 0.1 ug/L 21 week(s) (Biochemical) Eelgrass (Zostera marina)

OTHER TOXICITY: 3.2 ug/L 3-21 day(s) (Chlorophyl) Aquatic community (Aquatic community)

FATE AND TRANSPORT:
BIOCONCENTRATION: 1200 ug/L 48 hour(s) BCF (Residue) Bluegill (Lepomis macrochirus) 2.7 ug/L

ENVIRONMENTAL SUMMARY: Highly toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U154.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Methanol
ID NUMBER: UN1230
HAZARD CLASS OR DIVISION: 3
PACKING GROUP: II
LABELING REQUIREMENTS: 3

INTERNATIONAL U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Methanol
ID NUMBER: UN1230
HAZARD CLASS OR DIVISION: 3
PACKING GROUP: II
LABELING REQUIREMENTS: 3; 6.1

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Methanol
UN NUMBER: UN1230
CLASS: 3; 6.1

PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:
PROPER SHIPPING NAME: Methanol
UN NUMBER: UN1230
CLASS: 3
CLASSIFICATION CODE: FT1
PACKING GROUP: II
LABELS: 3(+6.1)

LAND TRANSPORT RID:
PROPER SHIPPING NAME: Methanol
UN NUMBER: UN1230
CLASS: 3
CLASSIFICATION CODE: FT1
PACKING GROUP: II
LABELS: 3; 6.1

AIR TRANSPORT IATA:
PROPER SHIPPING NAME: Methanol
UN/ID NUMBER: UN1230
CLASS OR DIVISION: 3
SUBSIDIARY RISK: 6.1
HAZARD LABELS: 3; 6.1
PACKING GROUP: II

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: Methanol
UN NUMBER: UN1230
CLASS OR DIVISION: 3
SUBSIDIARY RISK: 6.1
LABELS: 3; 6.1
UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Methanol
UN NUMBER: UN1230
CLASS OR DIVISION: 3
PACKING GROUP: II
SUBSIDIARY RISK(S): 6.1

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
METHYL ALCOHOL (METHANOL): 5000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):
Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):
Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: Yes
FIRE: Yes
REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
METHYL ALCOHOL (METHANOL)

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
T	Toxic

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:

EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 23/24/25	Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.
S 1/2	Keep locked-up and out of reach of children.
S 7	Keep container tightly closed.
S 16	Keep away from sources of ignition - No smoking.
S 36/37	Wear suitable protective clothing and gloves.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

CONCENTRATION LIMITS:

C>=20% T R 23/24/25-39/23/24/25
10%<=C<20% T R 20/21/22-39/23/24/25
3%<=C<10% Xn R 20/21/22-68/20/21/22

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 1

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

SYMYX TECHNOLOGIES, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: TRICHLOROETHYLENE

TRADE NAMES/SYNONYMS:
ACETYLENE TRICHLORIDE; ETHYLENE TRICHLORIDE; 1-CHLORO-2,2-DICHLOROETHYLENE; 1,1-DICHLORO-2-CHLOROETHYLENE; ETHINYL TRICHLORIDE; TRICHLOROETHENE; 1,1,2-TRICHLOROETHYLENE; 1,1,2-TRICHLOROETHENE; TCE; UN 1710; RCRA U228; C2HCl3; OHS23850; RTECS KX4550000

CHEMICAL FAMILY: halogenated, alkenes

CREATION DATE: Oct 24 1984
REVISION DATE: Dec 13 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: TRICHLOROETHYLENE
CAS NUMBER: 79-01-6
EC NUMBER (EINECS): 201-167-4
EC INDEX NUMBER: 602-027-00-9
PERCENTAGE: >99

OTHER CONTAMINANTS:
TRACES OF AMINES OR EPOXIDES AS INHIBITORS.

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=1 REACTIVITY=1

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: sweet odor
MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, central nervous system depression, allergic reactions, cancer hazard (in humans)
PHYSICAL HAZARDS: May decompose on contact with air, light, moisture, heat or storage and use above room temperature. Releases toxic, corrosive, flammable or explosive gases.

POTENTIAL HEALTH EFFECTS:
INHALATION:

SHORT TERM EXPOSURE: irritation, changes in blood pressure, nausea, vomiting, stomach pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, mood swings, tremors, loss of coordination, visual disturbances, bluish skin color, lung congestion, kidney damage, liver damage, unconsciousness, coma
LONG TERM EXPOSURE: same as effects reported in short term exposure, loss of appetite, weight loss, blood disorders, brain damage, cancer
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation, allergic reactions
LONG TERM EXPOSURE: irritation, allergic reactions, nausea, loss of appetite, weight loss, difficulty breathing, headache, drowsiness, dizziness, joint pain, loss of coordination, visual disturbances, paralysis
EYE CONTACT:
SHORT TERM EXPOSURE: irritation (possibly severe), blurred vision
LONG TERM EXPOSURE: irritation (possibly severe), eye damage
INGESTION:
SHORT TERM EXPOSURE: same as effects reported in short term inhalation
LONG TERM EXPOSURE: same as effects reported in long term inhalation

CARCINOGEN STATUS:
OSHA: No
NTP: Yes
IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For ingestion, consider gastric lavage. Consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Slight fire hazard.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

FLASH POINT: No data available.
LOWER FLAMMABLE LIMIT: 8%
UPPER FLAMMABLE LIMIT: 12.5%
AUTOIGNITION: 770 F (410 C)

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:
Reduce vapors with water spray. Collect runoff for disposal as potential hazardous waste.

SOIL RELEASE:
Trap spilled material at bottom in deep water pockets, excavated holding areas or within sand bag barriers. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:
Absorb with activated carbon. Remove trapped material with suction hoses. Collect spilled material using mechanical equipment. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Small liquid spills: Absorb with sand or other non-combustible material. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Store in a cool, dry place. Store in a well-ventilated area. Avoid heat, flames, sparks and other sources of ignition. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
TRICHLOROETHYLENE:
100 ppm OSHA TWA
200 ppm OSHA ceiling
300 ppm OSHA peak (5 minutes in any 2 hours)
50 ppm (269 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)
200 ppm (1070 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
10 ppm ACGIH TWA
25 ppm ACGIH STEL
25 ppm NIOSH TWA 10 hour(s)
2 ppm NIOSH ceiling 60 minute(s) (halogenated anesthetic gas)
DFG MAK (cutaneous absorption danger)
100 ppm (550 mg/m3) UK WEL TWA (skin)
150 ppm (820 mg/m3) UK WEL STEL (skin)

MEASUREMENT METHOD: NIOSH IV # 1022, 3800; OSHA # 1001

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
At any detectable concentration -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
COLOR: colorless
ODOR: sweet odor
MOLECULAR WEIGHT: 131.39
MOLECULAR FORMULA: Cl-C-H-C-Cl2
BOILING POINT: 189 F (87 C)
FREEZING POINT: -99 F (-73 C)
VAPOR PRESSURE: 58 mmHg @ 20 C
VAPOR DENSITY (air=1): 4.53
SPECIFIC GRAVITY (water=1): 1.4642
WATER SOLUBILITY: 0.1%
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: 21 ppm
EVAPORATION RATE: 0.69 (carbon tetrachloride=1)
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: alcohol, ether, acetone, chloroform, benzene, vegetable oils

10. STABILITY AND REACTIVITY

REACTIVITY: May decompose on contact with air, light, moisture, heat or storage and use above room temperature. Releases toxic, corrosive, flammable or explosive gases.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: bases, metals, combustible materials, oxidizing materials

TRICHLOROETHYLENE:
ALKALI: Forms explosive mixture.
ALUMINUM + DILUTE HYDROCHLORIC ACID: Violent poymerization.

ALUMINUM: Violent decomposition may occur on contact with aluminum powder or freshly formed surfaces.
BARIUM: Possible detonation.
BERYLLIUM: Forms impact-sensitive mixture.
BORON: Forms explosive or ignitable compound.
1-CHLORO-2,3-EPOXYPROPANE: Forms explosive mixture.
2,4-BIS(4(2',3'-EPOXYPROPOXY)PHENYL)PROPANE: Forms explosive mixture.
DI-2,3-EPOXYPROPYL ETHER OF 1,4-BUTANEDIOL: Forms explosive mixture.
EPOXIDES: Possible explosion.
LITHIUM: Forms impact-sensitive mixture.
MAGNESIUM: Forms impact-sensitive mixture.
METALS (POWDERED): Forms explosive or ignitable compound.
MONO-2,3-EPOXYPROPYL ETHER OF 1,4-BUTANEDIOL: Forms explosive mixture.
NITROGEN TETRAOXIDE: Forms explosive mixture.
OXIDIZERS (STRONG): Fire and explosion hazard.
OXYGEN (LIQUID): Explodes when initiated with a blasting cap.
OXYGEN (GAS): Explodes under pressure at room temperature.
PERCHLORIC ACID: Violent reaction.
POTASSIUM: Forms explosive chloroacetylenes.
POTASSIUM HYDROXIDE: Forms explosive dichloroacetylene when heated.
SODIUM: Forms explosive chloroacetylenes.
SODIUM HYDROXIDE: Forms explosive chloroacetylenes.
TITANIUM (POWDER): Forms impact-sensitive mixture.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: phosgene, halogenated compounds, oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

TRICHLOROETHYLENE:
IRRITATION DATA: 2 mg/24 hour(s) skin-rabbit severe; 20 mg/24 hour(s) eyes-rabbit moderate
TOXICITY DATA: 1 ml/kg oral-man TDLo; 7 gm/kg oral-human LDLo; 2143 mg/kg oral-man TDLo; 6900 mg/m3/10 minute(s) inhalation-human TCLo; 160 ppm/83 minute(s) inhalation-human TCLo; 812 mg/kg inhalation-human TCLo; 110 ppm/8 hour(s) inhalation-man TCLo; 2900 ppm inhalation-man LCLo; 500 ppm/16.1 year(s) intermittent inhalation-human TCLo; 4800 ppm/4 hour(s) inhalation-rat LCLo; 1282 mg/kg intraperitoneal-rat LD50; 150 mg/kg intratracheal-rat LDLo; 2402 mg/kg oral-mouse LD50; 8450 ppm/4 hour(s) inhalation-mouse LC50; 16 gm/kg subcutaneous-mouse LD50; 33900 ug/kg intravenous-mouse LD50; 1900 mg/kg intraperitoneal-dog LD50; 150 mg/kg subcutaneous-dog LDLo; 150 mg/kg intravenous-dog LDLo; 5864 mg/kg oral-cat LDLo; 32500 mg/m3/2 hour (s) inhalation-cat LCLo; 7330 mg/kg oral-rabbit LDLo; 11000 ppm inhalation-rabbit LCLo; >20 gm/kg skin-rabbit LD50; 1800 mg/kg subcutaneous-rabbit LDLo; 37200 ppm/40 minute(s) inhalation-guinea pig LCLo; 2000 ppm/70 minute(s) inhalation-rat TCLo; 250 mg/kg oral-rat TDLo; 4000 ppm/1 hour(s) inhalation-rat TCLo; 6000 ppm/6 hour (s) inhalation-rat TCLo; 1000 ppm/4 hour(s) inhalation-rat TCLo; 2000 ppm/2 hour(s) inhalation-rat TCLo; 3000 ppm/80 minute(s) inhalation-rat TCLo; 110 ppm/8 hour(s) inhalation-human TCLo; 450 ppm/6 hour(s) inhalation-mouse TCLo; 10000 ppm/4 hour(s) inhalation-mouse TCLo; 200 ppm/90 minute(s) inhalation-human TCLo; 220000 mg/m3/20 minute(s) inhalation-mouse LC50; 262000 mg/m3/30 minute(s) inhalation-mouse LC50; 16000 mg/m3/2 hour(s) inhalation-mouse LCLo; 40000 mg/m3/4 hour(s) inhalation-mouse LC50; 140700 mg/m3/1 hour(s) inhalation-rat LC50; 107000 mg/m3/2 hour(s) inhalation-rabbit LCLo; 53500 mg/m3/150 minute(s) inhalation-rabbit LCLo; 26750 mg/m3/14 hour(s) inhalation-rabbit LCLo; 2400 mg/kg oral-mouse LD50; 3000 mg/kg intraperitoneal-mouse LD50; 1440 mg/kg subcutaneous-mouse LD50; 4920 mg/kg oral-rat LD50; 2725 mg/kg intravenous-rat LD50; 20 ml/kg skin-rabbit LD50; 5680 mg/kg oral-dog LD50; 2725 mg/kg intraperitoneal-dog LD50; 30000 mg/m3/4 hour(s) inhalation-rat LCLo; 25000 mg/m3/2 hour(s) inhalation-mouse TCLo; 45000 mg/m3/5 hour(s) inhalation-cat TCLo; 90000 mg/m3/2 hour(s) inhalation-dog TCLo; 1.95 ppm/4 hour(s) inhalation-human TCLo; 500 ppm inhalation-human TCLo; 7000 mg/kg oral-human LDLo; 250 mg/kg intraperitoneal-mouse TDLo; 1200 mg/kg oral-rat TDLo; 5000

ppm/6 hour(s) inhalation-rat LCLo; 1500 mg/kg oral-mouse LD; 1500 mg/kg oral-mouse TDLo; 1500 mg/kg oral-rat TDLo; 500 mg/kg intraperitoneal-mouse TDLo; 50 mg/kg intraperitoneal-mouse TDLo; 1160 mg/kg/8 week(s) intermittent oral-rat TDLo; 84 gm/kg/2 week(s) continuous oral-rat TDLo; 130 gm/kg/13 week(s) intermittent oral-rat TDLo; 24 gm/kg/6 week(s) intermittent oral-rat TDLo; 4380 ppm/4 hour(s)-2 week(s) intermittent inhalation-rat TCLo; 3200 ppm/12 hour(s)-14 week(s) intermittent inhalation-rat TCLo; 150 ppm/24 hour(s)-30 day(s) continuous inhalation-rat TCLo; 2400 ppm/6 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 50 mg/m3/5 hour(s)-26 week(s) intermittent inhalation-rat TCLo; 300 ppm/24 hour(s)-12 week(s) continuous inhalation-rat TCLo; 60 gm/kg/15 week (s) intermittent subcutaneous-rat TDLo; 28 gm/kg/28 day(s) intermittent oral-rat TDLo; 48 gm/kg/4 week(s) intermittent oral-mouse TDLo; 49080 mg/kg/17 week(s) continuous oral-mouse TDLo; 150 ppm/24 hour(s)-30 day(s) continuous inhalation-mouse TCLo; 182 gm/kg/26 week(s) continuous oral-mouse TDLo; 13 gm/kg/5 day(s) intermittent oral-mouse TDLo; 3941 mg/kg/3 day(s) intermittent intraperitoneal-mouse TDLo; 10000 ppm/1 hour(s)-12 day(s) intermittent inhalation-mouse TCLo; 3825 mg/m3/8 hour(s)-6 week(s) intermittent inhalation-dog TCLo; 500 ppm/4 hour(s)-8 week(s) intermittent inhalation-dog TCLo; 350 ppm/4 hour(s)-12 week(s) intermittent inhalation-rabbit TCLo; 100 mg/m3/4 hour(s)-39 week(s) intermittent inhalation-rabbit TCLo; 400 ppm/7 hour(s)-35 week(s) intermittent inhalation-guinea pig TCLo; 150 ppm/24 hour(s)-30 day(s) continuous inhalation-gerbil TCLo; 320 ppm/24 hour(s)-90 day(s) continuous inhalation-gerbil TCLo; 2000 ppm/1 hour(s)-10 day(s) intermittent inhalation-rat TCLo; 2000 ppm/5 day(s) intermittent inhalation-rat TCLo; 500 ppm/4 week(s) intermittent inhalation-mouse TCLo; 376 ppm/30 day(s) intermittent inhalation-rat TCLo; 810 mg/m3/2 day(s) continuous inhalation-mouse TCLo; 14000 mg/kg/7 day(s) intermittent oral-rat TDLo; 5 ppm/17 year(s) intermittent inhalation-man TCLo; 102900 mg/kg/21 week(s) continuous oral-mouse TDLo; 2128 mg/kg/28 day(s) continuous oral-rat TDLo; 42483 mg/kg/21 week(s) continuous oral-rat TDLo; 500 ppm/6 hour(s)-26 week(s) intermittent inhalation-rat TCLo; 510 ppm/8 hour(s)-24 week (s) intermittent inhalation-gerbil TCLo; 170 ppm/8 hour(s)-24 week(s) continuous inhalation-gerbil TCLo; 125 gm/kg/10 week(s) intermittent intramuscular-rat TDLo; 1720 mg/m3/5 day(s) continuous intramuscular-rat TDLo; 257.5 gm/kg/103 week(s) intermittent oral-rat TDLo; 515 gm/kg/103 week(s) intermittent oral-rat TDLo; 600 ppm/7 hour(s)-104 week(s) intermittent inhalation-rat TCLo; 3200 ppm/6 hour(s)-1 week(s) intermittent inhalation-rat TCLo; 3200 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 3000 mg/kg/6 week(s) intermittent oral-mouse TDLo; 700 mg/kg/14 day(s) intermittent oral-rat TDLo; 44800 mg/kg/16 week(s) continuous oral-mouse TDLo; 67200 mg/kg/24 week(s) continuous oral-mouse TDLo; 65000 mg/kg/52 week(s) intermittent oral-rat TDLo; 50 ppm/8 hour (s)-6 week(s) intermittent inhalation-rat TCLo; 37 ppm/8 hour(s)-30 day(s) continuous inhalation-mouse TCLo; 300 ppm/7 hour(s)-104 week(s) intermittent inhalation-rat TCLo; 735000 mg/kg/105 week(s) continuous oral-mouse TDLo; 300 ppm/7 hour(s)-104 week(s) intermittent inhalation-mouse TCLo; 600 ppm/104 week(s) intermittent inhalation-mouse TCLo; 150 ppm/7 hour(s)-107 week(s) intermittent inhalation-mouse TCLo; 300 ppm/7 hour(s)-78 week(s) intermittent inhalation-mouse TCLo; 1312.8 mg/kg/78 week(s) intermittent oral-mouse TDLo; 984.6 mg/kg/78 week(s) intermittent oral-mouse TDLo; 525 gm/kg/105 week(s) intermittent oral-mouse TDLo; 24000 mg/kg/24 week (s) continuous oral-mouse TDLo; 150 ppm/6 hour(s)-104 week(s) intermittent inhalation-mouse TCLo; 600 ppm/7 hour(s)-78 week(s) intermittent inhalation-mouse TCLo; 450 ppm/5 day(s) intermittent inhalation-mouse TCLo; 1000 ppm/4 week(s) intermittent inhalation-mouse TCLo; 7 gm/kg/1 week(s) intermittent oral-mouse TDLo; 6.3 gm/kg/2 week(s) continuous oral-rat TDLo; 1000 ppm/1 week(s) continuous inhalation-mouse TCLo; 500 ppm/182 day(s) intermittent inhalation-rat TCLo; 84 gm/kg/12 week(s) continuous oral-mouse TDLo; 4500 mg/kg/3 day(s) intermittent oral-mouse TDLo; 1000 ppm/5 day(s) intermittent inhalation-mouse TCLo; 2250 mg/kg/3 day(s) intermittent oral-mouse TDLo; 3000 mg/kg/5 day(s) intermittent oral-mouse TDLo; 600 ppm/6 hour(s)-15 day(s) intermittent inhalation-rat TCLo; 560 mg/kg/4 week(s) continuous oral-mouse TDLo; 22400 ug/kg/16 week(s) continuous oral-mouse TDLo; 36400 ug/kg/26 week(s) continuous oral-mouse TDLo; 210 mg/kg/3 week(s) intermittent oral-mouse TDLo; 31500 mg/kg/3 week(s) intermittent oral-mouse TDLo; 21000 mg/kg/2 week(s) intermittent oral-mouse TDLo; 21000 mg/kg/2 week(s) intermittent oral-rat TDLo; 20 gm/kg/8 week(s) intermittent oral-rat TDLo; 5000 mg/kg/2 week(s) intermittent oral-rat TDLo; 1400 mg/kg/14 day(s) intermittent oral-mouse TDLo; 32500 mg/kg/13 week(s) intermittent oral-rat TDLo; 16250 mg/kg/13 week(s) intermittent oral-rat TDLo

CARCINOGEN STATUS: NTP: Anticipated Human Carcinogen; IARC: Human Limited Evidence, Animal Sufficient Evidence, Group 2A; ACGIH: A2 -Suspected Human Carcinogen; TRGS 905: K 3

Evidence of carcinogenicity in humans comes from seven cohort studies with specific trichloroethylene exposures well characterized for individual study subjects. A meta-analysis of these studies found that occupational exposure was associated with excess incidences of liver cancer, kidney cancer, non-Hodgkin's lymphoma, prostate cancer, and multiple myeloma, with the strongest evidence for the first three cancers. Exposure was assessed less acurately in case-control studies. In many of these studies, exposure was estimated from exposure to solvents in general. Elevated risks were most consistently observed for kidney cancer, liver cancer, Hodgkin's disease, non-Hodgkin's lymphoma, and cervical cancer. Repeated oral administration produced hepatocellular carcinomas in male and female mice;

hepatocellular adenomas in female mice; tubular cell neoplasms of the kidney and interstitial cell neoplasms of the testis in rats. Inhalation exposures resulted in increased incidences of liver and lung tumors in male and female mice and low incidences of adenocarcinomas of the renal tubules in rats. Increased incidences of interstitial testicular tumors in male rats were also observed.

LOCAL EFFECTS:
Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:
Moderately Toxic: ingestion
Slightly Toxic: inhalation
Relatively Non-toxic: dermal absorption

TARGET ORGANS: immune system (sensitizer), central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: heart problems

TUMORIGENIC DATA: 150 ppm inhalation-rat TCLo/7 hour(s)-2 year(s) intermittent; 455 gm/kg oral-mouse TDLo/78 week(s) intermittent; 150 ppm inhalation-mouse TCLo/7 hour(s)-2 year(s) intermittent; 100 ppm inhalation-hamster TCLo/6 hour(s)-77 week(s) intermittent; 912 gm/kg oral-mouse TD/78 week(s) intermittent; 500 ppm inhalation-mouse TC/6 hour(s)-77 week(s) intermittent; 150 ppm inhalation-mouse TC/7 hour(s)-2 year(s) intermittent; 515 gm/kg oral-mouse TD/2 year(s) intermittent; 515000 mg/kg oral-rat TDLo/103 week(s) intermittent; 515000 mg/kg oral-mouse TDLo/103 week(s) intermittent; 456 gm/kg unreported-mouse TDLo/28 week(s) intermittent; 912 gm/kg unreported-mouse TDLo/78 week(s) intermittent; 553 gm/kg oral-mouse TDLo/79 week(s) intermittent

MUTAGENIC DATA: mutation in microorganisms - Salmonella typhimurium 10 ug/plate (+/-S9); mutation in microorganisms - Escherichia coli 3300 umol/L (+S9); phage inhibition capacity - Escherichia coli 18 ug/well; mutation in microorganisms - Saccharomyes cerevisae 40 mmol/L (+S9); gene conversion and miotic recombination - Saccharomyes cerevisae 20 mmol/L; DNA damage - Saccharomyes cerevisae 22 mmol/L; sex chromosone loss and non disjunction - Saccharomyes cerevisae 11 mmol/L; mutation in microorganisms - Aspergillus nidulans 2500 ppm (-S9); sex chromosone loss and non disjunction - Aspergillus nidulans 17500 ppm; micronucleus test - other fish multiple 3 gm/L; cytogenetic analysis - other fish multiple 3 gm/L; unscheduled DNA synthesis - human lung 100 mg/L; DNA inhibition - human lymphocyte 5 ml/L; sister chromatid exchange - human lymphocyte 178 mg/L; micronucleus test - rat inhalation 5 ppm 6 hour(s)-continuous; micronucleus test - rat oral 4 mmol/kg; morphological transformation - rat embryo 1100 umol/L; DNA damage - rat liver 100 umol/L; unscheduled DNA synthesis - rat liver 2800 umol/L; unscheduled DNA synthesis - rat oral 16500 mg/kg 3 week(s)-intermittent; micronucleus test - mouse intraperitoneal 1 gm/kg; mutation in microorganisms - mouse lymphocyte 146 mg/L (+S9); specific locus test - mouse intraperitoneal 140 mg/kg; morphological transformation - mouse embryo 20 mg/L; DNA damage - mouse intraperitoneal 6 mmol/kg; DNA damage - mouse liver 100 umol/L; unscheduled DNA synthesis - mouse oral 2500 mg/L; unscheduled DNA synthesis - mouse bone marrow 1 mmol/L; other mutation test systems - mouse oral 600 mg/kg; host-mediated assay - mouse Saccharomyes cerevisae 400 mg/kg; sperm - mouse inhalation 100 ppm; morphological transformation - hamster embryo 5 mg/L; other mutation test systems - hamster fibroblast 1 pph; sister chromatid exchange - hamster ovary 401 mg/L; sex chromosone loss and non disjunction - hamster lung 1150 umol/L; DNA adduct - mammal lymphocyte 1 mmol/L; cytogenetic analysis - mouse skin 7 gm/kg; DNA repair - mouse intraperitoneal 100 mg/kg; DNA damage - rat kidney 1 mmol/L 20 hour(s); DNA damage - human kidney 1 mmol/L 20 hour(s); micronucleus test - rat kidney 1 mmol/L 48 hour(s); micronucleus test - human kidney 1 mmol/L 48 hour(s); micronucleus test - rat oral 3590 mg/kg; DNA damage - rat oral 3591 mg/kg; mutation in microorganisms - Salmonella typhimurium 5000 mg/L (-S9) 2 hour(s)

REPRODUCTIVE EFFECTS DATA: 2688 mg/kg oral-rat TDLo 1-22 day(s) pregnant female/21 day(s) post pregnancy continuous; 36 gm/kg oral-rat TDLo 15 day(s) pre pregnancy/1-21 day(s) pregnant female continuous; 1140 mg/kg oral-rat TDLo 14 day(s) pre pregnancy/21 day(s) post pregnancy continuous; 1800 ppm inhalation-rat TCLo/24 hour(s) 1-20 day(s) pregnant female continuous; 100 ppm inhalation-rat TCLo/4 hour(s) 6-22 day(s) pregnant female continuous; 1800 ppm inhalation-rat TCLo/6 hour(s) 1-20 day(s) pregnant female continuous; 100 ppm inhalation-rat TCLo/4 hour(s) 8-21 day(s) pregnant female continuous; 100 ppm inhalation-mouse TCLo/7 hour(s) 5 day(s) male; 150 ppm inhalation-mouse TCLo/24 hour(s) 4 week(s) male week(s) pre pregnancy/4 week(s) pregnant female/3 week (s) continuous; 176 gm/kg oral-mouse TDLo 15 week(s) male week(s) pre pregnancy/15 week(s) post pregnancy/3 week(s) continuous; 19 gm/kg oral-rat TDLo 15 week(s) male week(s) pre pregnancy/15 week(s) post pregnancy/3 week(s) continuous; 24.5 gm/kg oral-mouse TDLo 7 day(s) male day(s) pre pregnancy/7 day(s) pregnant female/21 day (s) continuous; 5.5 gm/kg oral-rat TDLo 7 day(s) male day(s) pre pregnancy/7 day(s) pregnant female/21 day(s) continuous; 76 mg/kg oral-rat TDLo multigenerations; 156 mg/kg oral-rat TDLo multigenerations; 10115 mg/kg oral-rat TDLo 7 day(s) male day(s) pre pregnancy/7 day(s) pregnant female/21 day(s) continuous; 700 mg/kg oral-mouse TDLo multigenerations; 1010 mg/kg oral-rat TDLo 6-15 day(s) pregnant female continuous; 8.4 mg/kg oral-mouse

TDLo 0 day(s) pregnant female-21 day(s) post pregnancy continuous; 84 mg/kg oral-mouse TDLo 0 day(s) pregnant female-21 day(s) post pregnancy continuous; 8.4 mg/kg oral-mouse TDLo multigenerations; 60.5 mg/kg oral-rat TDLo 1-11 day(s) pregnant female continuous
ADDITIONAL DATA: May cross the placenta. Stimulants such as epinephrine may induce ventricular fibrillation. The presence of tetrachloroethane as an impurity, or the consumption of alcoholic beverages, caffeine, or other drugs may enhance the systemic toxicity. One study shows an increased risk of leukemia for children whose fathers had occupational exposure to chlorinated solvents after the birth of the child. The incidence of kidney cancer is statistically elevated among workers exposed to trichloroethylene. One study suggest that exposure to high concentrations over prolonged periods of time may cause renal tumors in humans.

HEALTH EFFECTS:
INHALATION:
ACUTE EXPOSURE:
TRICHLOROETHYLENE: May cause mild irritation of the respiratory tract. Levels of 250-1000 ppm have caused impaired judgement and coordination. 1000-5000 ppm has caused excitation followed by central nervous system depression with drowsiness, dizziness, headache, nausea, vomiting, unconsciousness and coma. If consciousness is regained, nausea and vomiting may follow for several hours. Psychotic effects may include euphoria, disorientation, visual disturbances and hallucinations, and delusions. Other effects may include weakness, abdominal cramps, pallor, dyspnea, tachypnea, irregular pulse and heartbeat, pulmonary edema, hypotension, anesthesia, tremors, profuse perspiration, cyanosis, and rarely convulsions. Death may occur from respiratory arrest or ventricular fibrillation resulting in primary cardiac failure. Liver and kidney damage may also occur. Animal studies have also shown spleen damage. Trigeminal nerve damage and hepatotoxic effects have been attributed to exposure to the impure substance or to the decomposition products.

CHRONIC EXPOSURE:
TRICHLOROETHYLENE: Repeated exposure to levels below 300 ppm may cause nausea, vomiting, headache, abdominal cramps, sleepiness, drunkenness, flushing, anorexia, swelling of the eyes, face and hands, and mild cardiac arrhythmias. Other symptoms may include wheezing, weight loss, anorexia, joint and muscle pain, anemia, cranial and peripheral neuropathies, chemical hepatitis, cirrhosis, and rarely jaundice. Intolerance to alcohol and tobacco, tremor, giddiness, anxiety and cardiac arrhythmias have been found in workers chronically exposed to 5-630 ppm. Liver, kidney and brain damage may also occur. Rats exposed to whole body exposure at high concentrations resulted in ototoxicity. Reproductive effects have been reported in animals. Administration to mice was associated with an increased incidence of liver and lung tumors and a slight increase in adenocarcinomas of the renal tubules and increased incidences of interstitial testicular tumors in males rats.

SKIN CONTACT:
ACUTE EXPOSURE:
TRICHLOROETHYLENE: May cause irritation and contact dermatitis. May cause sensitization in previously exposed individuals and result in generalized exfoliative or papulovesicular dermatitis, and erythroderma. Skin contact with soaked clothing for a long period of time may result in blistering. May be absorbed through the skin, however, dermal absorption is not likely to be of toxicological significance under normal use.

CHRONIC EXPOSURE:
TRICHLOROETHYLENE: May cause a defatting type of dermatitis resulting in roughness, chapping, vesiculation and secondary infection. Repeated contact may result in paralysis of the fingers. Sensitization may occur. Repeated low level exposure may cause inebriation, irritability, and personality changes. Chronic absorption may also produce weight loss, nausea, anorexia, fatigue, visual impairment, joint pain and wheezing. Jaundice is rare.

EYE CONTACT:
ACUTE EXPOSURE:
TRICHLOROETHYLENE: Direct contact with vapor or liquid may cause burns of the lids, conjunctiva and cornea with symptoms of redness, tearing and blurred vision. A splash in the eye may cause smarting pain and injury to the corneal epithelium which may regenerate with complete recovery.

CHRONIC EXPOSURE:
TRICHLOROETHYLENE: Repeated and prolonged exposure may cause conjunctivitis, corneal inflammation, optic

neuritis, double vision, nystagmus, changes in color perception and blindness.

INGESTION:
ACUTE EXPOSURE:
TRICHLOROETHYLENE: May cause severe burning sensation in the mouth, throat, esophagus, and stomach, diarrhea, inebriation, confusion, tachycardia, and central nervous system depression with dizziness, nausea, vomiting, headache, collapse, convulsions, and coma followed by death from respiratory, cardiac or hepatorenal failure. Low-level concentrations may cause headache, amnesia, numbness, weakness of the extremities, hemiparesis and psychosis.

CHRONIC EXPOSURE:
TRICHLOROETHYLENE: May cause irritation of mucous membranes, headache, drowsiness, fatigue, giddiness, excitability, indigestion, nausea, disturbances of sensations in the extremities and other symptoms noted in chronic inhalation. Reproductive effects have been reported in animals. Repeated oral administration produced liver tumors in mice. Tubular cell neoplasms of the kidney and interstitial cell neoplasms of the testis were observed in rats.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:
FISH TOXICITY: 3100 ug/L 96 hour(s) LC50 (Mortality) Flagfish (Jordanella floridae)

INVERTEBRATE TOXICITY: 1700 ug/L 7 hour(s) EC50 (Regeneration) Flatworm (Dugesia japonica)

OTHER TOXICITY: 45000 ug/L 48 week(s) LC50 (Mortality) Clawed toad (Xenopus laevis)

FATE AND TRANSPORT:
BIOCONCENTRATION: 17 ug/L 1-14 hour(s) BCF (Residue) Bluegill (Lepomis macrochirus) 8.23 ug/L

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U228. Hazardous Waste Number(s): D040. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.5 mg/L.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Trichloroethylene
ID NUMBER: UN1710
HAZARD CLASS OR DIVISION: 6.1
PACKING GROUP: III
LABELING REQUIREMENTS: 6.1

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Trichloroethylene
UN NUMBER: UN1710
CLASS: 6.1
PACKING GROUP/RISK GROUP: III

LAND TRANSPORT ADR:
PROPER SHIPPING NAME: Trichloroethylene
UN NUMBER: UN1710
CLASS: 6.1
CLASSIFICATION CODE: T1

PACKING GROUP: III
LABELS: 6.1

LAND TRANSPORT RID:
PROPER SHIPPING NAME: Trichloroethylene
UN NUMBER: UN1710
CLASS: 6.1
CLASSIFICATION CODE: T1
PACKING GROUP: III
LABELS: 6.1

AIR TRANSPORT IATA:
PROPER SHIPPING NAME: Trichloroethylene
UN/ID NUMBER: UN1710
CLASS OR DIVISION: 6.1
HAZARD LABELS: 6.1
PACKING GROUP: III

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: Trichloroethylene
UN NUMBER: UN1710
CLASS OR DIVISION: 6.1
LABELS: 6.1
UN PACKING GROUP: III

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Trichloroethylene
UN NUMBER: UN1710
CLASS OR DIVISION: 6.1
PACKING GROUP: III

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
TRICHLOROETHYLENE: 100 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: Yes
FIRE: No
REACTIVE: Yes
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
TRICHLOROETHYLENE

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65:

Known to the state of California to cause the following:
TRICHLOROETHYLENE
Cancer (Apr 01, 1988)

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):

Xi	Irritant
	Carcinogen Category 2
	Mutagen Category 3

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:

T

EC RISK AND SAFETY PHRASES:

R 36/38	Irritating to eyes and skin.
R 45	May cause cancer.
R 52/53	Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R 67	Vapors may cause drowsiness and dizziness.
R 68	Possible risk of irreversible effects.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53	Avoid exposure - obtain special instructions before use.
S 61	Avoid release to the environment. Refer to special instructions/Safety data sheets.

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 3

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES
8. EXPOSURE CONTROLS, PERSONAL PROTECTION
11. TOXICOLOGICAL INFORMATION

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

SYMYX TECHNOLOGIES, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: VINYL CHLORIDE

TRADE NAMES/SYNONYMS:
CHLOROETHYLENE; CHLOROETHENE; CHLORETHENE; TROVIDUR; ETHYLENE MONOCHLORIDE; MONOCHLOROETHYLENE; MONOCHLORO ETHENE; VINYL CHLORIDE MONOMER; VINYL CHLORIDE, INHIBITED; RCRA U043; UN 1086; C2H3CL; OHS24940; RTECS KU9625000

CHEMICAL FAMILY: halogenated, aliphatic

CREATION DATE: Oct 16 1984
REVISION DATE: Jun 14 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: VINYL CHLORIDE
CAS NUMBER: 75-01-4
EC NUMBER (EINECS): 200-831-0
EC INDEX NUMBER: 602-023-00-7
PERCENTAGE: >99.9

OTHER CONTAMINANTS:
MAY CONTAIN TRACES OF PHENOL OR OTHER INHIBITORS

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=4 REACTIVITY=2

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: gas
ODOR: sweet odor
MAJOR HEALTH HAZARDS: harmful if swallowed, skin irritation, eye irritation, central nervous system depression, cancer hazard (in humans)
PHYSICAL HAZARDS: Flammable gas. May cause flash fire. Flash back hazard. Electrostatic charges may be generated by flow, agitation, etc. May polymerize. Containers may rupture or explode.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, nausea, difficulty breathing, irregular heartbeat, headache, drowsiness,

symptoms of drunkenness, disorientation, joint pain, lung congestion, nerve damage
LONG TERM EXPOSURE: impotence, bluish skin color, blood disorders, liver damage, cancer
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: irritation
EYE CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: irritation
INGESTION:
SHORT TERM EXPOSURE: no information on significant adverse effects
LONG TERM EXPOSURE: cancer

CARCINOGEN STATUS:
OSHA: Yes
NTP: Yes
IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115 F; 41-46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

EYE CONTACT: Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION: If swallowed, drink plenty of water, do NOT induce vomiting. Get immediate medical attention. Induce vomiting only at the instructions of a physician. Do not give anything by mouth to unconscious or convulsive person.

NOTE TO PHYSICIAN: For inhalation, consider oxygen. For ingestion, consider gastric lavage, activated charcoal slurry and catharsis.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Stop flow of gas.

FLASH POINT: -108 F (-78 C)

LOWER FLAMMABLE LIMIT: 3.6%
UPPER FLAMMABLE LIMIT: 33%
AUTOIGNITION: 882 F (472 C)

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:
Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Protect from physical damage. Store outside or in a detached building. Inside storage: Store in a cool, dry place. Store in a well-ventilated area. Avoid heat, flames, sparks and other sources of ignition. Keep separated from incompatible substances. Grounding and bonding required.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
VINYL CHLORIDE:
1.0 ppm OSHA TWA
5 ppm OSHA ceiling 15 minute(s)
0.5 ppm OSHA action level
1 ppm ACGIH TWA
NIOSH TWA (lowest feasible concentration)
5 mg/m3 (2 ml/m3) AGS TRK (others) (effective 1 Jan 2005 no longer valid per amendment)
8 mg/m3 (3 ml/m3) AGS TRK (production) (effective 1 Jan 2005 no longer valid per amendment)
7.77 mg/m3 (3 ppm) EC OEL TWA (BOELV)
3 ppm UK WEL TWA

MEASUREMENT METHOD: NIOSH IV # 1007; OSHA # 4, 75

VENTILATION: Provide local exhaust or process enclosure ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: For the gas: Wear appropriate chemical resistant gloves. For the liquid: Wear insulated gloves. OSHA REGULATED SUBSTANCES: U.S. OSHA 29 CFR 1910.1017.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.
OSHA Standard:
Respirator selection should comply with 29 CFR 1910.134, 29 CFR 1910.1017, and the final rule published in the Federal Register on August 24, 2006.
NIOSH Recommendations:
At any detectable concentration -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted canister providing protection against the compound of concern.
Any appropriate escape-type, self-contained breathing apparatus.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: gas
COLOR: colorless
ODOR: sweet odor
MOLECULAR WEIGHT: 62.50
MOLECULAR FORMULA: C-H2-C-H-CL
BOILING POINT: 9 F (-13 C)
FREEZING POINT: -245 F (-154 C)
VAPOR PRESSURE: 2515.6 mmHg @ 21.1 C
VAPOR DENSITY (air=1): 2.2
SPECIFIC GRAVITY (water=1): 0.9106
WATER SOLUBILITY: 0.25%
PH: Not applicable
VOLATILITY: Not applicable
ODOR THRESHOLD: 260 ppm
EVAPORATION RATE: Not applicable
VISCOSITY: 0.01072 cP @ 20 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not applicable
SOLVENT SOLUBILITY:
Soluble: alcohol, ether, carbon tetrachloride, benzene

10. STABILITY AND REACTIVITY

REACTIVITY: May polymerize. Avoid contact with light or storage and use above room temperature.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

INCOMPATIBILITIES: metal carbide, metals, oxidizing materials, peroxides

VINYL CHLORIDE:
ACETYLIDE-FORMING MATERIALS: May form explosive compounds.
ALUMINUM: May cause polymerization.
COPPER AND ALLOYS: May form explosive compounds.
IRON: May corrode in the presence of water.
MONEL: May form explosive compound.
NITROGEN OXIDES: Explodes.

OXIDIZERS (STRONG): Fire and explosion hazard.
PEROXIDES: May initiate polymerization.
STEEL: May corrode in the presence of water.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products: phosgene, halogenated compounds, oxides of carbon

POLYMERIZATION: May polymerize. Avoid contact with heat, light, air, water or incompatible materials. Closed containers may rupture violently.

11. TOXICOLOGICAL INFORMATION

VINYL CHLORIDE:
TOXICITY DATA: 500 mg/kg oral-rat LD50; 18 pph/15 minute(s) inhalation-rat LC50; 20 pph/30 minute(s) inhalation-mouse LCLo; 30 pph/30 minute(s) inhalation-guinea pig LCLo; 200 ppm/18 minute(s) inhalation-mammal LCLo; 1056000 mg/m3/15 minute(s) inhalation-mouse LCLo; 185000 mg/m3/1 hour(s) inhalation-mouse LCLo; 258000 mg/m3/90 minute(s) inhalation-guinea pig TCLo; 1552000 mg/m3/18 minute(s) inhalation-guinea pig LCLo; 517000 mg/m3/1 hour(s) inhalation-dog TCLo; 1034000 mg/m3/4 hour(s) inhalation-dog LCLo; 260000 mg/m3 inhalation-dog LC50; 1320 mg/m3/7 hour(s) inhalation-human TCLo; 16000 mg/m3/5 minute(s) inhalation-human TCLo; 23400 mg/kg/13 week(s) intermittent oral-rat TDLo; 30 mg/m3/4 hour(s)-26 week(s) intermittent inhalation-rat TCLo; 5000 ppm/7 hour(s)-52 week(s) intermittent inhalation-rat TCLo; 400 mg/m3/24 hour(s)-14 week(s) continuous inhalation-rat TCLo; 28000 ppm/7 hour(s)-6 week(s) intermittent inhalation-rat TCLo; 2000 ppm/8 hour(s)-92 day(s) intermittent inhalation-rat TCLo; 9 gm/m3/4 hour(s)-22 week(s) intermittent inhalation-rabbit TCLo; 30 mg/m3/26 week(s) intermittent inhalation-rabbit TCLo; 30 mg/m3/4 hour(s)-20 day(s) intermittent inhalation-rat TCLo; 30 mg/m3/4 hour(s)-18 week(s) intermittent inhalation-rat TCLo; 300 mg/m3/4 hour(s)-28 week(s) intermittent inhalation-rat TCLo; 30 mg/m3/4 hour(s)-4 week(s) intermittent inhalation-rabbit TCLo; 900 mg/m3/8 week(s) continuous inhalation-rabbit TCLo; 1100 ppm/4 week(s) intermittent inhalation-rat TCLo
CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human Sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 -Confirmed Human Carcinogen; EC: Category 1; TRGS 905: K 1
Studies show occupational exposure resulted in a significant increase in angiosarcomas of the liver, and also tumors of the brain, lung, and hematopoietic systems. Vinyl chloride was carcinogenic in rats, mice, and hamsters following oral and inhalation exposure, producing angiosarcomas of the liver and also tumors at various sites, and was carcinogenic in rats following prenatal exposure.
LOCAL EFFECTS:
Irritant: skin, eye
ACUTE TOXICITY LEVEL:
Toxic: ingestion
Relatively Non-toxic: inhalation
TARGET ORGANS: central nervous system
TUMORIGENIC DATA: 200 ppm inhalation-man TCLo/14 year(s) intermittent; 3463 mg/kg oral-rat TDLo/52 week (s) intermittent; 1 ppm inhalation-rat TCLo/4 hour(s)-52 week(s) intermittent; 10000 ppm inhalation-rat TCLo/4 hour (s) 12-18 day(s) pregnant female continuous; 21 mg/kg intraperitoneal-rat TDLo/65 week(s) intermittent; 21 mg/kg subcutaneous-rat TDLo/67 week(s) intermittent; 50 ppm inhalation-mouse TCLo/30 week(s) intermittent; 50 ppm inhalation-hamster TCLo/4 hour(s)-30 week(s) intermittent; 50 ppm inhalation-rat TC/7 hour(s)-26 week(s) continuous; 100 ppm inhalation-rat TC/7 hour(s)-26 week(s) continuous; 50 ppm inhalation-mouse TC/47 week(s) intermittent; 34 gm/kg oral-rat TD/3 year(s) intermittent; 50 ppm inhalation-mouse TC/6 hour(s)-4 week(s) intermittent; 50 ppm inhalation-mouse TC/4 hour(s)-30 week(s) intermittent; 250 ppm inhalation-rat TC/2 year(s) intermittent; 300 mg/m3 inhalation-human TC/1 week(s) continuous; 5 ppm inhalation-rat TC/4 hour(s)-52 week(s) intermittent; 50 ppm inhalation-rat TC/6 hour(s)-43 week(s) intermittent; 128 mg/m3 inhalation-rat TCLo/1 year(s) continuous; 77000 mg/m3 inhalation-rat TCLo/6 minute(s)
MUTAGENIC DATA: mutation in microorganisms - Salmonella typhimurium 2000 ppm (+S9) 48 hour(s); mutation in microorganisms - Salmonella typhimurium 1 pph (-S9); mutation in microorganisms - Escherichia coli 10600 umol/L (+S9); DNA repair - Escherichia coli 100 ug/plate; specific locus test - Drosophila melanogaster inhalation 48500 ppm; sex chromosone loss and non disjunction - Drosophila melanogaster inhalation 1 pph; gene conversion and

miotic recombination - Saccharomyes cerevisae 48 mmol/L 3 hour(s); mutation in microorganisms - Schizosaccharomyces pombe 16 mmol/L (+S9) 30 minute(s); cytogenetic analysis - human HeLa cell 10 mmol/L; mutation in mammalian somatic cells - human lymphocyte 7500 ppt; morphological transformation - rat inhalation 2000 ppm 14 week(s)-intermittent; DNA adduct - rat oral 18 gm/kg 2 year(s)-continuous; DNA damage - rat inhalation 205 ppm 5 hour(s); unscheduled DNA synthesis - rat liver 2100 umol/L; DNA inhibition - rat intravenous 9500 ug/kg; cytogenetic analysis - rat inhalation 150 ug/m3 14 week(s)-continuous; host-mediated assay - rat Saccharomyes cerevisae 1 pph 24 hour(s)-continuous; micronucleus test - mouse inhalation 5 pph 4 hour(s); morphological transformation - mouse embryo 75 mg/L; host-mediated assay - mouse Schizosaccharomyces pombe 700 mg/kg; host-mediated assay - mouse Saccharomyes cerevisae 700 mg/kg; micronucleus test - hamster embryo 30 pph; mutation in microorganisms - hamster lung 20 pph (+S9) 5 hour(s); cytogenetic analysis - hamster inhalation 12500 ppm 6 hour(s); cytogenetic analysis - hamster multiple 600 mg/kg; sister chromatid exchange - hamster inhalation 12500 ppm 6 hour (s); mutation in mammalian somatic cells - hamster ovary 10 pph; mutation in microorganisms - Salmonella typhimurium 50 pph

REPRODUCTIVE EFFECTS DATA: 30 mg/m3 inhalation-man TCLo 5 year(s) male; 100 ppm inhalation-rat TCLo/6 hour(s) 26 week(s) male; 500 ppm inhalation-rat TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 1500 ppm inhalation-rat TCLo/24 hour(s) 1-9 day(s) pregnant female continuous; 250 ppm inhalation-rat TCLo/6 hour (s) 55 day(s) pre pregnancy continuous; 30000 ppm inhalation-mouse TCLo/6 hour(s) 5 day(s) male; 500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 500 ppm inhalation-rabbit TCLo/7 hour(s) 6-18 day(s) pregnant female continuous

ADDITIONAL DATA: Stimulants such as epinephrine may induce ventricular fibrillation.

HEALTH EFFECTS:
INHALATION:
ACUTE EXPOSURE:

VINYL CHLORIDE: May be irritating. Exposure to 1000-16,000 ppm may cause central nervous system depression with drowsiness, vertigo, staggering gait, tingling and numbness of hands and feet, impaired hearing and vision, cardiac arrhythmias and possibly unconsciousness; 20,000-25,000 ppm for 3-5 minutes may cause dizziness, lightheadedness, disorientation, nausea and burning sensation of the soles of the feet; and 120,000 ppm may be fatal. Additional effects may include narcolepsy, headache, undue fatigue, muscle and joint pain, dyspnea, and anesthesia. Death may be due to respiratory paralysis with cardiac arrest. Human and animal pathologic reports show pulmonary edema, hyperemia of kidneys and liver, and hepatic degeneration.

CHRONIC EXPOSURE:

VINYL CHLORIDE: Repeated exposure may result in dose-related sensory disorders, autonomic nervous system polyneuritis, spastic angioneuritis, leukopenia, thrombocytopenia, splenomegaly, hepatitis-like liver changes, liver malfunction with portal fibrosis, impotence and pulmonary insufficiency. Workers involved in the polymerization process may exhibit a peculiar triad of symptoms: Modification of peripheral circulation resulting in pallor, cyanosis, and then redness (Raynaud's phenomenon); skeletal changes of distal phalanges (acro-osteolysis); and scleroderma like skin changes. Pseudo-clubbing of the fingers may also occur. Occupational exposure has produced angiosarcomas of the liver and is associated with tumor production at other sites. Animal studies show that vinyl chloride is carcinogenic in rats following prenatal exposure. One study suggested an increased fetal mortality due to exposure of the fathers to vinyl chloride. Several studies have reported an increased rate of birth defects, especially central nervous system anomalies, in the children of parents residing in commumities where vinyl chloride production and polymerization plants are located.

SKIN CONTACT:
ACUTE EXPOSURE:

VINYL CHLORIDE: Contact may cause irritation with redness and pain. Due to rapid evaporation, the liquid may cause frostbite with redness, tingling, and pain or numbness. In more severe cases, the skin may become hard and white and develop blisters.

CHRONIC EXPOSURE:

VINYL CHLORIDE: Workers handling vinyl chloride have exhibited a peculiar triad of symptoms: Raynaud's phenomenon, acro-osteolysis, and scleroderma like skin changes. Repeated or prolonged exposure to irritants may cause dermatitis.

EYE CONTACT:
ACUTE EXPOSURE:
VINYL CHLORIDE: Contact may cause immediate and severe irritation, and corneal injury with complete recovery in 48 hours. Due to rapid evaporation, the liquid may cause frostbite with redness, pain and blurred vision.

CHRONIC EXPOSURE:
VINYL CHLORIDE: Repeated or prolonged exposure to irritants may cause conjunctivitis.

INGESTION:
ACUTE EXPOSURE:
VINYL CHLORIDE: The reported lethal dose in rats is 500 mg/kg. The symptoms were not reported. If the liquid is swallowed, frostbite damage to the lips, mouth and mucous membranes may occur.

CHRONIC EXPOSURE:
VINYL CHLORIDE: Oral administration to rats, mice, and hamsters resulted in tumor production at various sites, including angiosarcomas of the liver.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:
FISH TOXICITY: 388000 ug/L 10 month(s) LETH (Mortality) Northern pike (Esox lucius)

INVERTEBRATE TOXICITY: 41.74 ug/L 72 day(s) (Residue) Mosquito (Culex pipiens quinquefasciata)

ALGAL TOXICITY: 41.74 ug/L 72 day(s) (Residue) Green algae (Oedogonium cardiacum)

13. DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U043. Hazardous Waste Number (s): D043. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.2 mg/L. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
ID NUMBER: UN1086
HAZARD CLASS OR DIVISION: 2.1
LABELING REQUIREMENTS: 2.1
QUANTITY LIMITATIONS:
PASSENGER AIRCRAFT OR RAILCAR: Forbidden
CARGO AIRCRAFT ONLY: 150 kg

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS: 2.1

LAND TRANSPORT ADR:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS: 2
CLASSIFICATION CODE: 2F

LABELS: 2.1

LAND TRANSPORT RID:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS: 2
CLASSIFICATION CODE: 2F
LABELS: 2.1; (+13)

AIR TRANSPORT IATA:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN/ID NUMBER: UN1086
CLASS OR DIVISION: 2.1
HAZARD LABELS: 2.1

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS OR DIVISION: 2.1
LABELS: 2.1

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Vinyl chloride, stabilized
UN NUMBER: UN1086
CLASS OR DIVISION: 2.1

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
Vinyl chloride: 1 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: Yes
FIRE: Yes
REACTIVE: Yes
SUDDEN RELEASE: Yes

SARA TITLE III SECTION 313 (40 CFR 372.65):
Vinyl chloride

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65:
Known to the state of California to cause the following:
Vinyl chloride
Cancer (Feb 27, 1987)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):

F+	Extremely Flammable
	Carcinogen Category 1

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:

EC RISK AND SAFETY PHRASES:

R 12	Extremely flammable.
R 45	May cause cancer.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53	Avoid exposure - obtain special instructions before use.

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 2

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION